PB-218 183

THE COST OF CLEAN WATER. VOLUME III. INDUSTRIAL WASTE PROFILES NO. 2. MOTOR VEHICLES AND PARTS

Federal Water Pollution Control Administration
Washington, D.C.

24 November 1967

DISTRIBUTED BY:

NTIS

National Technical Information Service
U. S. DEPARTMENT OF COMMERCE
5285 Port Royal Road, Springfield Va. 22151

PB 218 183

The Cost of Clean Water

U.S. DEPARTMENT OF THE INTERIOR
Federal Water Pollution Control Administration

VOLUME III

INDUSTRIAL WASTE PROFILE NO. 2

BOTTLE WASHING AND BEVERAGE

Reproduced by
NATIONAL TECHNICAL
INFORMATION SERVICE
U S Department of Commerce
Springfield VA 22151

Other publications in the Industrial Waste Profile series

FWPCA Publication No. I.W.P.- 1:	Blast Furnace and Steel Mills
FWPCA Publication No. I.W.P.- 3:	Paper Mills
FWPCA Publication No. I.W.P.- 4:	Textile Mill Products
FWPCA Publication No. I.W.P.- 5:	Petroleum Refining
FWPCA Publication No. I.W.P.- 6:	Canned and Frozen Fruits and Vegetables
FWPCA Publication No. I.W.P.- 7:	Leather Tanning and Finishing
FWPCA Publication No. I.W.P.- 8:	Meat Products
FWPCA Publication No. I.W.P.- 9:	Dairies
FWPCA Publication No. I.W.P.-10:	Plastics Materials and Resins

THE COST OF

CLEAN WATER

Volume III

Industrial Waste Profiles
No. 2 - Motor Vehicles and Parts

U. S. Department of the Interior
Federal Water Pollution Control Administration

For sale by the Superintendent of Documents, U.S. Government Printing Office
Washington, D.C., 20402 - Price 70 cents

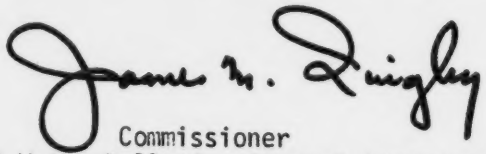
I

PREFACE

The Industrial Waste Profiles are part of the National Requirements and Cost Estimate Study required by the Federal Water Pollution Control Act as amended. The Act requires a comprehensive analysis of the requirement and costs of treating municipal and industrial wastes and other effluents to attain prescribed water quality standards.

The Industrial Waste Profiles were established to describe the source and quantity of pollutants produced by each of the ten industries studied. The profiles were designed to provide industry and government with information on the costs and alternatives involved in dealing effectively with the industrial water pollution problem. They include descriptions of the costs and effectiveness of alternative methods of reducing liquid wastes by changing processing methods, by intensifying use of various treatment methods, and by increasing utilization of wastes in by-products or water reuse in processing. They also describe past and projected changes in processing and treatment methods.

The information provided by the profiles cannot possibly reflect the cost or wasteload situation for a given plant. However, it is hoped that the profiles, by providing a generalized framework for analyzing individual plant situations, will stimulate industry's efforts to find more efficient ways to reduce wastes than are generally practiced today.



Commissioner
Federal Water Pollution Control Administration

INDUSTRIAL WASTE PROFILE STUDY

MOTOR VEHICLES AND PARTS

Prepared for F.W.P.C.A.

FWPCA CONTRACT NUMBER. 14-12-99

NOVEMBER 24, 1967

FEDERAL WATER POLLUTION CONTROL ADMINISTRATION

NOVEMBER 1967

II b

SCOPE OF MATERIAL COVERED

This report has been prepared with the primary objective of developing a pollution profile for the Motor Vehicle and Motor Vehicle Equipment Industry. Basically this has involved the development of material flow patterns together with the expected quantity of pollutants from each fundamental operation. Projected waste loads and treatment trends have been provided. The replacement values for the existing treatment facilities as well as the anticipated costs for future treatment practices have been included in terms of both capital and operating costs. Existing and projected waste loads and treatment practices have been established for that part of the Motor Vehicle Industry that can be characterized as stamping plants, body and final assembly operations only. Although these three operations involve less than 5% of the total Motor Vehicle Industry plant operations (93 of 1,950), it involves almost 70% of the total employees (445,000 of 649,401) and accounted for approximately 23% (35 billion gallons per year of 148 billion gallons per year) of the total Motor Vehicle parts and industry water intake in 1966.

There are in excess of 1700 automobile parts and accessory plants in the United States which generate a variety of pollutants independent of production and in some cases process technology. Considerably more detailed information would be required for plants in this category to develop a complete, similar profile study. Generally pollutants associated with these plants are oil, heavy metals, cyanide, suspended solids, alkalis, acids and solvents.

TABLE OF CONTENTS

	Subject	Page No.
	Preface	ii
	Scope	iii
	Table of Contents	iv
	Summary	1
	STAMPING, BODY ASSEMBLY, FINAL ASSEMBLY	
I.	Processes and Wastes	
	A. Description of Processes & Pollutants	14
	B. Significant Pollutants	16
	C. Re-Use of Process Waters	21
	D. Subprocess Mix	22
	E. Discussion of Subprocesses	25
	F. Subprocess Technology	26
II.	Gross Waste Quantities Before Treatment or Other Disposal	28
III.	Waste Reduction Practices	
	A. Processing Practices	34
	B. Treatment Practices	35
	C. By-Product Utilization	44
	D. Base Year Net Waste Quantities	45
	E. Projected Net Waste Quantities	45
IV.	Waste Reduction or Removal Cost Information	46
	Exhibits	51
	PARTS AND ACCESSORIES	
I.	Processes and Wastes	
	A. Description of Processes & Pollutants	67
	B. Significant Pollutants	72
	C. Re-Use of Process Waters	80
	D. Subprocess Mix	80
	E. Discussion of Subprocesses	80
	F. Subprocess Technology	81
II.	Gross Waste Quantities Before Treatment or Other Disposal	83
III.	Waste Reduction Practices	
	A. Processing Practices	84
	B. Treatment Practices	84
	C. By-Product Utilization	91
	D. Base Year Net Waste Quantities	92
	E. Projected Net Waste Quantities	92
IV.	Waste Reduction or Removal Cost Information	93
	Exhibits	94
	Acknowledgement	115
	References	116

INDUSTRIAL WASTE PROFILE STUDY
MOTOR VEHICLE AND PARTS INDUSTRY

SUMMARY OF REPORT

The automotive and related industries are concerned primarily with the manufacture of cars, trucks and buses, although most of the automotive manufacturing companies are also engaged in other manufacturing endeavors which are unrelated to the production of vehicles (cars, trucks and buses). These unrelated manufacturing operations are not considered further within the scope of this report.

Automobile production in the United States is centered in five manufacturers, General Motors Corporation, Ford Motor Company, Chrysler Corporation, American Motors Corporation and Kaiser Jeep Corporation, accounting for more than 99% of the total automobile production in the United States. Truck and bus production is distributed among a larger number of manufacturers, but representing on the average of about 16% of the total number of vehicles produced in the United States.

The vehicle production operations can broadly be classified into parts production, body assembly and final assembly. *

Each of the five automobile manufacturers have their own final assembly and body assembly operations. The major manufacturers also have a certain number of parts plants although a number of automotive parts are manufactured by independent agencies.

The scope of this report is to fully evaluate the pollution abatement needs of a portion of the automotive industry, namely, final assembly operations, body assembly operations and preparation of major body parts (stamping operations).

In addition generalized and order of magnitude information is developed for the parts and accessories portion of the motor vehicle

* The terms, final assembly and vehicle assembly, are used interchangeably.

industry. Full evaluation was not possible due to the complexity of this portion of the industry and the time commitment to complete the study.

To simplify our presentation we will discuss separately (1) those operations associated with preparation of major body parts (stamping), body assembly and final assembly and (2) those operations associated with parts and accessories manufacturing.

Stamping, Body Assembly and Final Assembly

For automobile production these operations of stamping, body assembly and final assembly are all carried out in plants owned by the five manufacturers noted above. For truck and bus production, there are an additional number of manufacturers. The five automotive companies noted above have a total of 225 operating plants (the actual total will vary from time to time). Of this total, 25 can be considered as producing major body parts (stamping) and 68 can be viewed as assembly plants (either body assembly, final assembly, or a combined operation). The remainder, 132 plants, are parts plants that are not within the scope of the first part of this study. In addition to this figure, there are a large number of automotive parts plants that are not owned by the five major automotive companies. Therefore, this report will concern itself first with the pollution abatement needs of the 25 major body parts plants (stamping plants), the 68 automobile assembly plants plus the similar operations producing trucks and buses.

The method of producing trucks and buses is similar to the method of producing an automobile so the following discussion will in general pertain to both.

In the stamping operation, for the production of major body parts, the metal (normally strip or sheet steel) is first cut to size and then is stamped into the desired shape using large hydraulic presses. Portions of the stamped parts are normally welded together in the stamping operation.

From the stamping operation the parts are sent to the body manufacturing facility. In conventional industry terminology the body refers to the passenger enclosure from the fire wall back and the term does not include the front end parts such as the front fenders and hood. In the body assembly plant, the body is first constructed

from the stamped metal parts (this part of the body plant is referred to as the body shop), and then is treated and painted (paint shop). Following this operation, the exterior and interior trim is added to the trim shop. The interior and exterior trim is produced in parts plants.

From the body assembly operations, the completed body goes to the assembly plant. First the chassis, wheels and power train (engine, transmission assembly, etc.) are assembled from parts produced elsewhere. Then this assembled chassis joins with the already assembled body. Finally, the front end parts (fenders, hood, etc.) are added. The hood, fenders, etc. are stamped in a conventional stamping plant and are normally painted in the final assembly plant.

The stamping plants are separate from the body and final assembly operations. For Ford and Chrysler the body and final assembly operations are normally combined. For General Motors, body assembly is generally handled by the Fisher Body Division while final assembly is handled by one of the assembly divisions. In some cases the body assembly and final assembly plants are located on the same plant site in which case they can be considered as one facility. In other cases the body assembly and final assembly operations are carried out at separate locations.

Significant Wastes Produced

A. Stamping Plants

These operations produce no significant liquid processing wastes per se. Only small amounts of water are used in processing directly. Large amounts of oils (both lubricating and hydraulic) are used, and in many cases some of these invariably find their way into the sewer system. Because there oils originate from a variety of points in the plant and because their introduction into the sewer system is of a miscellaneous nature, the concentration in the plant effluent can vary widely. Ranges of extractable material of 50 mg/l to several thousand mg/l have been encountered. The flow of contaminated process water will be, as noted above, quite small varying from approximately 2000 gallons per day to 10,000 gallons per day.

Cooling water is used in large amounts for welding system cooling water. Recirculation of cooling water is widely practiced, so in most cases the cooling water discharge will be restricted to cooling system blowdown. This can, however, represent the major part of the plant water discharged. For typical stamping plants the cooling system blowdown can vary from 25 gallons per minute to 150 gallons per minute. Powerhouse water (boiler blowdown, boiler water pretreatment system blowdown, etc.) can also represent a source of contaminants.

B. Assembly Plants

The waste waters discharged from final assembly plants, body assembly plants or combined operations are of the same general type. These can be described as organic waste waters containing suspended solids. These materials primarily originate from the painting and paint sanding operations.

In addition heavy metals such as zinc and chromium which originate in metal treating (bonderizing) operations can be present. Powerhouse and cooling water can also be present, but the amount relative to the overall plant discharge will be considerably less than with stamping plants.

Because the waste waters are primarily organic in nature and contain suspended solids they are similar to sanitary waste water, but normally the organic content (as measured by the biochemical oxygen demand and chemical oxygen demand tests) and suspended solids will be higher than are found in typical sanitary wastes.

The processes which produce liquid wastes are essentially uniform throughout the industry. There are no anticipated new processes which will materially add to the pollution load. One new process, namely electrostatic painting, may in the future effect a reduction in pollution loading. In a typical painting operation, a water curtain is used in the paint booth to entrap paint oversptray which otherwise could present an environmental pollution problem. This water is discharged (after a

significant amount of reuse), and it represents a major source of contaminants, primarily organic materials and suspended solids. With electrostatic painting there is less overspray, in fact sometimes the water curtain can be eliminated entirely thus eliminating this source of contaminants. It appears that this technique will not be widely used in the foreseeable futrue as a replacement for existing equipment, but it will probably be tried where some new facilities are constructed. As such it will probably not make a significant contribution in major body painting in the next decade, but thereafter it may become increasingly important.

In general, processes that produce liquid wastes are uniform throughout this industry, and these have not and probably will not materially change over the next decade with the exception of electrostatic painting noted above. Also, the processes will not vary between small and large plants, the differentiation in plant size being based upon speed of the production line and hours of operation per day.

On this basis, the average amounts of waste produced per 100 cars for body assembly and final assembly has been developed and is summarized as follows for the pertinent items.

	Pounds/100 cars
Chemical Oxygen Demand (COD)	1,007.77
Biochemical Oxygen Demand (BOD)	322.33
Hexavalent Chromium (CrO_4)	4.50
Trivalent Chromium (CrO_4)	2.08
Zinc (Zn)	1.12
Suspended Solids	360.30
	Gallons/100 cars
Flow	201,958

The above figures can be expanded for a total 1963 automobile production of 7,637,728 units.

	Pounds x 10^6 Discharged
Chemical Oxygen Demand (COD)	68.60
Biochemical Oxygen Demand (BOD)	25.20
Hexavalent Chromium (CrO_4)	0.35
Trivalent Chromium (CrO_4)	0.16
Zinc (Zn)	0.09
Suspended Solids	29.00

	Gallons Discharged x 10^9
Flow	15.80

These figures can further be expanded by a factor of 1.16 to correct for truck and bus production yielding:

	Pounds x 10^6 Discharged
Chemical Oxygen Demand (COD)	79.53
Biochemical Oxygen Demand (BOD)	29.33
Hexavalent Chromium (CrO_4)	0.41
Trivalent Chromium (CrO_4)	0.19
Zinc (Zn)	0.10
Suspended Solids	34.60

	Gallons Discharged x 10^9
Flow	18.38

These figures are expanded for the years 1968 - 1972 and 1977 in the body of the report.

As noted previously the wastes produced from stamping operations are not related to production. With regard to flow for stamping plants, the 1963 values are in the range of 45 million gallons per year.

Treatment Methods

A. Stamping Plants

Stamping plant treatment systems are of several types. If the cooling water, powerhouse water etc. does not require treatment and if the concentrated waste can be collected separately, the treatment system will usually consist of a batch system for removal of oil and possibly suspended solids. Alternately, in this case, incineration has been used for the concentrated oil containing waste water.

If, on the other hand, the cooling water and powerhouse water requires treatment or if the concentrated waste water cannot be separated from the general plant collection system, an end of line facility for removal of suspended solids and oil is dictated. The overall efficiency for the removal of suspended solids is in the range of 85 - 95% and for oil is in the range of 85 - 95%.

B. Assembly Plants

Typical waste facilities for assembly plants will incorporate chemical clarification followed by conventional biological treatment such as the activated sludge process. Provision for reducing hexavalent chromium is incorporated while trivalent chromium and other heavy metals will be removed in the clarification step. The removal of heavy metals including chromium is essentially complete. Normal efficiencies for removal of organic material as measured by the chemical oxygen demand and biochemical oxygen demand tests are in the range of 80 - 95% and for suspended solids in the range of 85 - 95%.

Several modifications of this general approach can be used, and these are detailed in the body of the report.

Since the waste waters from assembly operations are basically organic in nature, they can be sent to municipal sewage treatment facilities. However, it is usually necessary to first adjust the pH and remove the heavy metals including chromium. Also the concentrations of chemical oxygen demand, biochemical oxgyen demand and suspended solids are usually higher than in conventional sanitary waste. As a result, pretreatment to remove excess suspended solids (some organic material is removed with suspended solids) is normally provided. After such pretreatment, it is the general practice of the industry to discharge to municipal systems where possible rather than to provide secondary biological treatment on the plant site.

Cost Summary

Costs have been developed for capital and operating expenses for stamping plants and assembly plants. Stamping plant costs will generally be independent of plant size whereas assembly plant costs will be a function of size. For assembly plants, the total number of plants have been classified as small, medium and large plants.

This information is summarized as follows:

CAPITAL COSTS
1966 BASIS

	Cost	Number of Plants	Total	Subtotals
Assembly Plants				
Small Plants	$ 500,000	8	$ 4,000,000	
Medium Plants	$ 835,000	48	$40,080,000	
Large Plants	$1,370,000	12	$16,440,000	$60,520,000
Cost Of Separate Waste Water Collection System For 30 Plants At $300,000 Per Plant			$ 9,000,000	$69,520,000
Less Credit For Secondary Systems Not Required[2]			$ 8,964,000	$60,556,000
Less Credit For Plants Already Installed			$14,500,000	$46,056,000
Total For Assembly Plants				$46,056,000
Stamping Plants				
Estimated Capital Costs				
Case I	$ 150,000	7[1]	$ 1,050,000	
Case II	$ 175,000	6[1]	$ 1,050,000	
Case III	$ 50,000	6[1]	$ 300,000	
Case IV	$ 60,000	6[1]	$ 360,000	$ 2,760,000
Cost Of Separate Waste Water Collection System For 11 Plants At $300,000 Per Plant			$ 3,300,000	$ 6,060,000
Less Credit For Systems Already Installed			$ 600,000	$ 5,460,000
Total For Stamping Plants				$ 5,460,000
Total For Assembly & Stamping Plant Operations				$51,516,000
Expanded By 1.16 For Trucks & Buses				$59,759,000
Add 30%[3]			$18,000,000	$77,759,000

[1] Assume 25% of plants in each category.

[2] Assume 60% will not be required in each category.

Secondary Costs	Small	$105,000	X	4.8*	=	$ 504,000
	Medium	$200,000	X	28.8*	=	$5,760,000
	Large	$375,000	X	7.2*	=	$2,700,000
						$8,964,000

* No. of Plants

[3] Control Building, Site Preparation, Engineering And Construction Supervision.

287-025 O - 68 - 2

OPERATING COSTS
(300 Days Per Year)
1966 Basis

	Costs $/Year	Number of Plants	Total	Subtotal
Assembly Plants				
Small Plants	$ 47,900	8	$ 383,200	
Medium Plants	$ 80,000	48	$3,873,600	
Large Plants	$149,400	12	$1,792,800	
				$ 6,049,600
Plus Estimated Cost Of Sending Secondary Effluent To Municipal Systems[1]			$5,472,000	
				$11,521,600
Less Savings In Secondary Power Cost			$ 500,000	
Total For Assembly Plants				$11,021,600
				$11,021,600
Stamping Plants				
Estimated Operating Costs				
Case I	$ 14,700	7	$ 102,900	
Case II	$ 17,700	6	$ 106,200	
Case III	$ 7,050	6	$ 42,300	
Case IV	$ 7,800	6	$ 46,800	
Total For Stamping Plants				$ 298,200
				$ 298,200
Total For Assembly And Stamping Plant Operations				$11,319,800
Expanded By 1.16 For Trucks And Buses				$13,130,000

[1]

	No. of Plants	gpd	
Small	4.8	1×10^6	4.8×10^6
Medium	28.8	2×10^6	51.6×10^6
Large	7.2	4×10^6	28.8×10^6
Total Flow to Municipal System			91.2×10^6 at $0.20/1000 gal = $18,240/day = $ 5,472,000/year

Parts and Accessories

There are approximately 1700 parts and accessories plants in the United States. They produce a multiplicity of parts by a variety of processes. Insufficient time was available to fully develop information on this segment of the industry.

In reviewing the parts that comprise an automobile and the wastes discharged as a result of these operations, we have arbitrarily divided this industry into segments based on the characteristics of the wastes produced. The division is as follows:

A. Primarily Oil Containing Waste

In machining operations oil is introduced into water as a result of the cleaning operation. Also, the emulsified oil systems must be periodically dumped and cleaned. Small amounts of phosphate, metals, caustic and solids may be produced in this operation.

The major contaminant from die casting operations is oil in the cooling water. The other contaminant is metal chips or solids from the buffing operation. In the buffing operation wet air scrubbers are used to remove suspended particles from the air, and this water must be dumped periodically.

The major contaminants from the manufacture of wheels are oils. Soluble oil is used as a lubricant and cooling agent during the shaping operations. These oils must be periodically dumped.

B. Primarily Non-Oil Containing Waste

The primary contaminant discharged from metal (sand) casting operations is suspended solids. Organic material from the binders and rosin may present biochemical oxygen demand and color problems of varying degrees of magnitude.

The primary contaminants from plating processes are alkali, acid, cyanide and heavy metals, such as copper, nickel and chromium.

Major contaminants from radiator manufacturing processes are acid and heavy metals such as copper and zinc. Oil is discharged from the metal rolling operation, if present, and solids and solvents are discharged from the paint operation.

The main contaminants produced from battery manufacturing are sulfuric acid and lead. Acid is discharged from the initial charging operation. The lead is generated from the production of paste and general operational procedures.

The contaminants produced from air conditioner unit manufacturing processes are acid, heavy metals such as aluminum and chromate and fluoride.

Wastes discharged from plastic parts manufacturing operations come from the painting or plating operation. These are solids, solvents, copper, acid, nickel and chromium.

The primary contaminant from the manufacture of rubber parts is solids. Some organic material may be introduced into the waste during the curing process.

Negligible contaminants are introduced into waste water from windshield manufacturing operations.

Treatment methods for these wastes are substantially as follows:

Oil Containing Wastes

If the soluble oil can be collected separately, the treatment facility may actually consist of two parallel facilities. One facility would include batch holding tanks for emulsion breaking followed by chemical clarification facilities. The other facility would be a flow through system and would include pH adjustment followed by chemical clarification and precipitation.

Alternate facilities could consist of a batch emulsion breaking system with the effluent being blended with the general plant effluent which is then treated for pH adjustment and clarified by the addition of coagulants.

Non-Oil Containing Wastes

Solids & BOD Wastes

Treatment facilities for these wastes would consist of a lagoon where the solids would settle out. The lagoon would be sized so that the BOD load would be reduced by natural reaeration.

Plating Wastes

Suitable treatment facilities for plating wastes would include cyanide destruction, chromium reduction, pH adjustment and removal of heavy metals as the hydroxides by precipitation.

Other Non-Oil Wastes

This facility would be the type wherein one stream would require pretreatment and the general plant waste would require pH adjustment and clarification.

Operating and capital costs have been developed for representative plants.

We estimate that the capital expenditure by the parts and accessories segment of the industry could be approximately $185,000,000, allowing no credit for existing facilities. The operating costs are in the range of $10-15,000,000 per year.

BODY AND VEHICLE ASSEMBLY

I. PROCESSES AND WASTES

A. Description of Processes and Pollutants

Because of the nature of the automotive market, the automobile assembly manufacturing processes used by the various manufacturers are very similar.

This manufacturing process is generally classified into two major categories, body manufacturing and automobile assembly; refer to Exhibit I. These two operations may be carried out at one or separate locations. The first step in the manufacturing process is the stamping out of the metal parts that go into the body assembly of the automobile. This body assembly usually includes that portion of the car that houses the passengers and rear portions of the body. However, it may in some cases include the body portions anterior to the passenger area. The second operation is the assembly of these stamped parts into a complete structural body. Most of the interior is added in this operation so that the unit may be added later in the manufacturing process as a complete assembly to the rest of the automobile buildup. While this body assembly is taking place, the chassis is concurrently assembled so that the completed body and chassis will meet at a particular point in the manufacturing process.

The following table generally describes the fundamental assembly processes, beginning materials, product and pollutants of each major operation:

I. STAMPING (Refer to Exhibit II)

Raw or Beginning Materials	Fundamental Processes	Final Product	Pollutants
1. Strip or Sheet Steel	Metal Cutting	Cut Steel	Oil, Metal Scraps, (Fine & Coarse)
2. Cut Steel	Pressing	Shaped Metal Parts	Oil, Metal Scraps
3. Shaped Metal Parts	Welding	Reinforced & Partially Assembled Parts	Cooling Waters

2. BODY ASSEMBLY (Refer to Exhibit II)

Raw or Beginning Materials	Fundamental Processes	Final Product	Pollutants
1. Reinforced & Partially Assembled Parts	Body Assembly	Assembled Body (unpainted)	Metals, Sanding Grit, (Minor Amounts)
2. Assembled Body Parts	Metal Treating and Painting	Painted Body	Chemicals, Metals, Primers, Solvents, Sanding Grit, Paint, etc., Paint Stripping, Contaminants, i.e.- Chemicals, Caustic Metals, etc.
3. Painted Body	Trimming	Finished Body	Cleaning Agents, Misc. Solids, Chemicals, etc. (Minor Amounts)

3. VEHICLE ASSEMBLY (Refer to Exhibit III)

Raw or Beginning Materials	Fundamental Processes	Final Product	Pollutants
1. Power and Running Parts	Power and Running Assembly	Assembled Power Train	Paint, Chemicals, etc.
2. Power Train & Finished Body	Wiring and Misc. As-	Assembled and Wired Body & Power Train	Metal Fines, Misc. Contaminants
3. Body & Power Train & Front End Parts	Mating & Final Assembly	Assembled Vehicle	Misc. Contaminants, Solids, etc.
4. Assembled Vehicle	Final Touches (Painting, Waxing, Water Test & Adjustments	Finished Vehicle	Paints, Metals, Chemicals & Misc. Contaminants

The process for truck and bus production is essentially the same.

B. Significant Pollutants

The significant pollutants associated with the motor vehicle manufacturing industry cover a wide variety and will have to be identified and discussed for each of the various above indicated processes.

1. Body Stamping

In the body stamping process, there are usually three distinct operations performed. The first operation is the cropping or cutting of the flat, raw strip or sheet steel into the appropriate

size for each particular part of the automobile body. Washing of the metal to clean the surface is occassionally included. There is generally no acid cleaning involved, and the only contaminants produced are oil or dirt from the metal surface and the cleaning agents or other chemicals used in the cleaning process. The second operation may be classified as pressing. After the metal is cut, the individual pieces are pressed or stamped into the desired shape. Again, this is a fairly clean operation, and the only significant contaminants are very fine metal chips and oils (machine oil and hydraulic oil) from the presses. The final step in the stamping process is the welding of structural frame supports or braces to the stamped metal parts for the body and the piecing together of some of the body components. Cooling water used in the welding system may be a source of contaminants.

Overall, there are no other wastes of considerable flow in the stamping process other than from the manufacturing process previously discussed. However, there are other waste streams connected with this operation that contribute incidental contaminants. These waste streams are:

1. Sanitary Wastes
2. Storm Water Runoff
3. Powerhouse Contaminants
   (Boiler Blowdown, Softener
   Regenerants, Flyash)
4. Cooling Tower Blowdown

2. Body Assembly

After the stamping process, the pieces are sent to the body plant which is normally a separate facility from the stamping plant. Here the automobile body is made ready for mating with the rest of the car. The body plant usually contains three main areas of operation, the body shop, the paint shop, and the trim shop. The overall body plant is an area that

can produce significant amounts of pollutants due to the painting and metal treating facilities. The first operation at the body plant is the assembly of the stamped body parts wherein the seams of these parts are lead-filled or soldered. The main pollutants produced in this operation are the fine metals and sanding grit from the finishing of the body. At this point, the doors and trunk lid are added to the body. After completion of this operation the body has taken its shape and has assumed a particular identity for painting and interior-exterior trimming.

A variety of contaminants may be produced by the next operation (metal treating and painting). The completed body shell is first "bonderized" to retard the spread of rust in the body during consumer use. This operation varies, dependent on the automobile manufacturer, but the main pollutants are from the bonderizing chemicals used and the fine metal solids dissolved as a result of the bonderizing operation. Also, a small amount of oil might be produced in some cases.

After the body is dried, the car is primed, redried and sanded. The major pollutants in this operation are the primer, solvents and chemicals used in priming. Other pollutants might be the sand grit and metals from the sanding operation. At this point, the car receives its outer paint coat. Again, the pollutants are quite similar to the primer operation, in that chemicals and paint are the principal pollutants. The outside of the basic body is essentially completed at this point, and the next operation, the trim shop, deals mostly with the interior of the body exterior trim and overall body tests. Most of the interior assembly (fabrics, glass, metal trim, plastics, etc.) is made outside of the body plant and the body plant only installs these parts. The pollutants from this operation are miscellaneous including chemicals and some fine metal solids.

In the body plant, paint strippers may be used.

These contribute contaminants such as dissolved metals and perhaps phenol. In addition to these pollutants, the incidental contaminants which were described for the stamping plant might be included also. The completed body will later join the rest of the automobile near the end of the assembly line.

3. Vehicle Assembly

This operation may be a separate facility or combined with a body assembly operation.

A. Undercarriage and Power Train

While the body is being made, the rest of the automobile is being assembled simultaneously. The first part of this assembly is the mating of the frame, axles and suspension. Before this is done, the frame (chassis) is painted. The main pollutants from the painting operation are paint, chemicals and solvents. Then the motor and drive train are installed in the chassis, and the wheels are added. The pollutants from this phase of the operation would consist of primarily miscellaneous contaminants (oils, grease and some fine metals). The individual parts for the power train and chassis assembly are not made at the assembly plant.

B. Miscellaneous Operations and Washings

After completion of the undercarriage, the body from the body plant is mated to the frame or the chassis. The wiring and miscellaneous installation of minor parts are made on the almost finished automobile. The next major step is the assembling of the fenders, hood, grille and bumpers. The hood and front fenders are normally painted and prepared in the final assembly plant. Plating of parts such as bumpers is normally performed elsewhere. The

contaminants from the hood and front fender painting area are the same as those from the large body plant except a smaller quantity is produced. After this final assembly of the front end, miscellaneous small assemblies such as seat installation, wiring, final paint checks, and testing of the whole car, the automobile is ready for shipment to the dealer. In these last final assembly operations and inspections, there are no major pollutants produced except for miscellaneous pollutants due to paint touch up and oil and grease used in the adjustments, tests, and car washing.

Truck Assembly

Simultaneously with automobile assembly in a plant, a truck assembly line may also be in operation. This line is similar to the automobile line except that truck body assembly would probably be included in the vehicle assembly plant operations. Consequently, the pollutants of an assembly plant may include those of a truck body plant which could contribute a considerable amount to the plant waste load depending on the size of the truck line.

Included in the contaminants for the overall assembly plant would be those of the incidental type (sanitary wastes, storm water, powerhouse and cooling water).

As noted in the preceding discussion of processes and contaminants, thermal waste discharges do not appear to be of significance, primarily because of the widespread use of recirculated cooling water for welding processes, etc.

Water borne wastes generally do not constitute a potential air pollution problem in this industry. In fact

one of the major water uses is installed to minimize environmental air pollution, namely recirculating water in a paint spray booth.

When some of the contaminants are separated from the plant waste stream, a sludge or slurry is produced. In some cases these are incinerated for ultimate disposal. Properly designed incineration facilities should not result in an air pollution problem. Open pit incineration of removed oils has been periodically practiced at some installations resulting in an air pollution problem, but this trend is definitely not continuing.

C. In order to estimate the percentage and quantity of process water re-used in 1964, the specific definition of process water as it relates to the automobile industry must first be established, since dependent on the particular case the utility waters (cooling water) may or may not be included in the definition of process waters.

For purposes of this report the process water will be considered as the water specifically associated with the product, that is, waters having immediate contact with the product or by-products or their wastes.

The only significant quantity of process water in the motor vehicle industry that is re-used is that water used in the painting operation. This water is used as a water barrier or curtain recirculated on one or both sides of the painting booths for the primary purpose of impinging on the excess paint aerosols or particles and confining them to the recirculating water, thus preventing discharge to the atmosphere.

The flow rate of the water barrier for a typical production booth is approximately 5,000 gallons per minute. Based on the average time of 5.35 minutes per car to pass through a paint booth, a recirculated water curtain of 27,000 gallons per car is used. Approximately 10,000,000 cars[1] and trucks were produced in 1964 producing a gross water curtain flow of 270 billion gallons

per year (1964). It must be borne in mind that paint booths have classically employed a water curtain and this is often not considered as water re-use in the normal sense.

In bonderizing lines, spray rinses are employed, and these are recirculated systems with a continuous overflow and make-up. This represents a minor portion of the total recirculated water employed in an assembly plant. Recirculated water systems are associated with the paint spray booths, bonderizing lines, leak testing and some miscellaneous uses. These systems are dumped periodically to waste. Losses occur in use due to evaporation. It is estimated that approximately 33% of the intake water is used in recirculating systems.

Auxiliary recirculating cooling water systems are being used more and more in plants constructed in this industry. It has been estimated that water usage for this industry would be double present usage if recirculation was not being used in the plants.

D. The following table indicates the estimated percentage of plants employing the process.

ESTIMATED PERCENTAGE OF PLANTS EMPLOYING PROCESS *

Process	Subprocess	1967
STAMPING		27%
	Chop Shear	
	Pressing	
	Welding	
BODY ASSEMBLY		12%
	Body Bonderizing	
	Small Parts Bonderizing	
	Priming	
	Wet Sanding	
	Painting-Lacquer-Body	
	" -Small Parts	
	" -Quarter Panel	
	Paint Strippers	
VEHICLE ASSEMBLY		10%
	Sheet Metal Bonderizing	
	Chassis-Black Coating	
	Priming	
	Wet Sanding	
	Painting-Lacquer	
	Paint Strippers	
COMBINED VEHICLE & BODY ASSEMBLY **		51%

* This relative plant mix will vary little from year to year.

** Includes combined General Motors body and assembly operations at the same site.

As indicated previously, the subprocesses used to bring about the fundamental processes are primarily universal throughout the industry with the exception of different brand name compounds which are used. These compounds are fundamentally of the same chemical constituents, however.

287-025 O - 68 - 3

The basic process of stamping involves the cutting of the metal, pressing it into shape and initial support welding. Any alternative techniques of widespread use are unknown; therefore, the table simply expresses the estimated percentage of plants employing the process at the time of data collection.

The second fundamental process of body assembly has been subclassified in the table into the major operations or subprocesses used. The body assembly process usually involves a body bonderizing operation, a small parts bonderizing operation, and the priming, wet sanding and painting of the body. Essentially this process, due to production demands, has been condensed to the basic processes that are necessary to produce the end result, a finished body. Primarily General Motors Corporation employs a separate body assembly plant* whereas the other companies combine this operation with the final assembly operations. In the table, the percentage of combined body and final assembly plants includes those General Motors operations which are located at the same plant site.

The final fundamental process of vehicle assembly which yields the marketable product is also a universal technique in the automobile industry. In addition to body assembly (if not previously assembled by a body plant), this process includes further washing, painting and sanding and final trimming which produce the completed automobile.

The specific methodology used was to first classify all of the plants into one of the three categories (stamping, body assembly and final assembly) and establish the percentage of each. The second step was to determine automobile production through the years1 and to check this with information obtained for each of the three large companies (General Motors, Ford and Chrysler). Comparisons were made which indicated

* The body assembly operation may be located adjacent to the final assembly operation.

that for the body and vehicle assembly operations the rate of production can vary in the same plant simply by operating the production line or lines for more hours per day. Consequently, there is no definite or direct relationship between production and number of plants.

In this industry, process technology as it relates to liquid wastes has not materially changed since 1950, and it is not expected to change materially in the next decade. While specific chemicals used, paint compositions, etc. may change the general character of waste waters discharged should remain reasonably constant.

The one new process which can reduce the amounts of contaminants is electrostatic painting, which eliminates in many cases the need for the water curtain.

Therefore, both the processes and subprocesses are basically uniform throughout the industry and are not expected to materially change over the next 10 years.

E. Plant subprocesses producing particularly difficult waste problems are generally limited to body and final assembly operations and are generally confined to:

1. Paint booth water curtain discharges.
2. Paint stripping.
3. Bonderizing operations.

Although the recirculating water curtain is utilized to entrap most of the excess paint, a build-up becomes evident in the recirculation tanks, and batch dumping as bleed-off of the tanks becomes necessary. Also, the stripping of paint from associated equipment becomes essential over various time periods. Drag out (liquid which clings to the automobile part after treatment) of the bonderizing solutions and the rinse water from the bonderizing operations present problems since they eventually terminate in the final plant waste streams. High chemical oxygen demand (COD) and

biochemical oxygen demand (BOD) loadings are usually the immediate concern in the design of waste treatment facilities, along with significant amounts of suspended solids and heavy metals including chromium. Part of the suspended solids are sand and grit from the body sanding operations.

Oil and lubricants from the power train assembly are evidenced, but again they are controlled by confinement to specific areas and may be segregated from the other waste streams for special disposal or treatment.

F. In the automobile manufacturing industry, the differentiation between innovation, obsolescense and typical process is not as easily identified in the processing technology as it is in the design and engineering of the product itself. The technology being basically a simple one of shaping parts, assembling them, and coating them is a function of time; consequently, the changes over the years have been directed toward increasing the speed of flow of these operations. This has for the most part been a function of increasing the speed or number of production lines in a given plant or increasing the number of plants manufacturing a particular product to meet consumer demand.

The development of electrostatic painting of certain parts of the motor vehicle (at this time it is not used for the entire automobile) can reduce the quantities of paint waste. This process is one that utilizes the principle of directing the paint particle to the surface of a part by an electrical field thus reducing or eliminating the overspray. This process, if universally applied would provide considerable reduction of the amount of pollutants in the waste streams.

Automobile assembly plants usually have a range of possible operation and usually produce at a rate dictated by demand. However, an arbitrary classification might be established by labeling those plants capable of producing almost 2000 vehicles per day (2 - 60 car per hour lines operating for 16 hours per day) as large plants; those capable of producing up to 1000 vehicles

per day (1 - 60 car per hour line operating for 16 hours per day) as a medium size plant and those capable of producing 500 cars per day (1 - 50 car per hour line operating for 8 hours) as a small plant.

Those plants having truck and bus assembly lines would be classified differently since their rate of production is lower.

II. GROSS WASTE QUANTITIES BEFORE TREATMENT OR OTHER DISPOSAL

A. As indicated previously, the processing technologies of the automotive industry are very similar. This close similarity has prevailed for many years and is expected to continue. The fact that these fundamental automobile processing technologies have remained similar suggests that either the technology has been refined as much as possible under the circumstances, or that the processing technologies involving liquid wastes are implicitly fundamental. Because of the foregoing, the question arises as to whether the industry is far ahead or far behind any potential new process technology. It is our opinion that new process technology will not materially affect liquid waste discharges over the next decade.

On this basis, the gross waste quantities will be described under "typical" processes only and the units of pollutants for assembly operations will be based on pounds per 100 automobiles. The reason for the use of these units is because the contaminants are a function of the quantity of product, information pertaining to yearly automobile production is readily available, and this will provide for projections into the future.

It will be noted that the stamping plant operations discharge much less and different types of waste (primarily oil) than the body assembly and vehicle assembly plants. For this reason they will be treated separately.

1. Body and Final Assembly Plants

Exhibits IV and V indicate the typical waste quantities and waste water volumes associated with the previously identified subprocessing operations. Exhibit IV provides the quantities of contaminants and flow volumes of the various batch process tank dumps and rinses apportioned to each 100 automobile bodies treated. Although these tanks are dumped intermittently on a regular time schedule as indicated, the overall contaminant load and process flow reaching the final waste stream can be assessed

on a per automobile basis. Since these quantities result in very low values, this final assessment is provided on a 100 bodies treated basis. One can note that the body plant waste water when compared to the assembly plant waste contains greater concentrations of contaminants and flows. This is principally due to the greater amount of treatment, painting and finishing of the body surfaces.

Exhibit V provides the quantities of contaminants and flow volumes from body and final assembly plants of the final effluent prior to treatment. Since these samples were collected during periods when the batch process tanks were not being discarded, these values represent the continuous conditions in the absence of batch dumps. These values (Exhibit V) must be included with the contaminant and flow waste loads from the previously indicated operations (Exhibit IV) in order to establish the overall final untreated waste load.

Stamping Plants

Liquid wastes, other than cooling water, produced from stamping plant operations will be relatively independent of plant size. In fact, such liquid wastes are of a miscellaneous nature, and the amount will bear little if any relationship to plant production. For an average size stamping facility the amount of contaminated waste water discharged will be in the range of 2000 to 10,000 gallons per day. Plant size and therefore production rate will not appreciably affect this figure. An average value would be 6,000 gallons per day. In addition there can be cooling water and powerhouse water. For this type of facility the cooling water (recirculating cooling system blowdown) can vary from 25 - 150 gpm and therefore can represent the major flow discharged.

2. Body and Final Assembly Plants

Exhibit VI indicates the total waste quantities and waste water volumes that can be expected from a

motor vehicle body plant and a motor vehicle final assembly plant again based on units of 100 car bodies. As indicated previously, the motor vehicle industry lacks substantial deviation from the "typical" level of technology, therefore, the values of the contaminant waste load and water flow volumes can be considered to represent that for the industry.

Stamping Plants

The volume of waste water is not related to production technology for this operation.

3. Body and Final Assembly Plants

As noted by Exhibit VI, the total waste and waste water quantities are already represent in units of physical product (actually in units per 100 physical products). This was done in this fashion principally because the total industry may or may not combine body and final assembly operations into one physical plant; however, each product must be exposed to each operation, hence, the total contaminant load per 100 bodies will be independent of whether the body and final assembly operations are combined or carried out in separate facilities.

Stamping Plants

The volume of waste water is not related to quantities of physical product in the category.

4. Body and Final Assembly Plants

Exhibits VII and VIII indicate the total waste quantities and waste water volume produced by the industry in base year (1963), and the projected years up to 1977. Exhibit VII provides the total waste load for the body and final assembly plants separately for the industry while Exhibit VIII provides the total waste load quantities for the combined operations (which represents the waste load on a final product basis).

Because of the differences of values of the final product which are not necessarily a function of the waste load contribution, the product value added basis is not used. Instead, the total number of vehicles produced by the industry in base year (1963) was used. This figure was 9,100,436 passenger cars, motor trucks and busses. This figure when multiplied by the contaminant loads indicated in Exhibits IV, V, and VI provides the total waste load for the base year (1963). By the same method, total waste load for the industry was obtained for the subsequent years up to 1965.

As noted by Exhibit VIII, the approximate total process waste water volume discharged was 18.3 billion gallons containing 40,000 tons of COD, 15,000 tons of BOD, 17,000 tons of suspended solids, 200 tons of hexavalent chromium, 250 tons of iron, 150 tons of aluminum and 50 tons of zinc.

Stamping Plants

The average amount of specific process waste water discharged from a typical stamping plant is 6,000 gallons per day and there were 25 automobile stamping plants in 1963. This indicates a total flow in the range of 150,000 gallons per day from this type of facility. This figure excludes cooling water which may or may not require treatment.

5. Body and Final Assembly Plants

As noted by Exhibits VII and VIII, the projected gross waste and waste water load for the years up to 1977 are given on the same basis; that is total yearly production. These yearly production projections are based on the total yearly automobile production rates projection using a 3.6% increase per year[2] prediction as a maximum and the straight line extrapolation from the previous years' total production[1] estimated at a rate of 2.5% as a minimum which provides a median annual increase of 3% per year. On this basis the total wastes and waste water volumes are predicted to increase approximately 185% by 1977.

Stamping Plants

Product values added are not a valid criteria for this type of facility since waste waters produced are independent of production. Waste water increases will be related only to the construction of new facilities. Based upon projection of 3% expansion per year, stamping plant production will increase as follows:

1963 Base Year	% Increase Over 1963
1968	17.0
1969	20.5
1970	24.1
1971	27.7
1972	31.5
1977	52.5

It is anticipated that approximately 75% of this increase will be reflected in increased production by existing facilities which will not appreciably increase the amount of waste water discharged. The remainder will represent new facilities which will increase the amount of water discharged. The projection is:

	% Increase in New Facilities	Projected Waste Water Volumes Million Gallons Per Day
Base Year 1963	----	0.150
1968	4.25	0.156
1969	5.12	0.158
1970	6.02	0.159
1971	6.92	0.160
1972	7.88	0.161
1977	13.12	0.169

6. Body and Assembly Plants

As noted, waste production of body and assembly plants is directly proportional to the production rate. Any

seasonal variations will primarily be due to increased consumer demand, increased inventories in anticipation of shutdowns and model changeover.

Increased consumer demand causing sporadic increased production periods do not necessarily adhere to any seasonal pattern or time schedule but is probably the most frequent cause of excess waste loads as with any industry.

The introduction of new models in the fall of each year usually brings about an increased waste load in late summer because of widespread dumping of the batch process tanks to ready them for new process solutions.

Stamping Plants

Other than model changeover (approximately one month per year) production will vary in relation to sales requirements. This should, however, have a minimal effect on waste produced. During model changeover the volume of strength of the waste waters may vary somewhat.

III. WASTE REDUCTION PRACTICES

A. Processing Practices

As has been described previously, the processes used throughout the industry are quite similar. Moreover, production technology, with one possible exception, has not and probably will not materially affect the amount or type of liquid discharges. It is fair to say that this is true for stamping plants, body assembly plants and final assembly plants.

The one exception noted above is electrostatic painting. This technique has only been applied to date on a limited basis to small parts.

In electrostatic painting, the paint is mechanically sprayed onto the part through an electrical field. Virtually all of the paint is placed on the part being painted, essentially eliminating the need for a water curtain to entrap the paint overspray.

Since the discharges of paint booth water represents a significant portion of the contaminant load from a typical body assembly or final assembly plant the advent of electrostatic painting would materially reduce the pollution load.

It appears, at present, that this process will not be widely used for painting of major body parts prior to 1977, at least.

In a typical body plant or final assembly plant the major contaminants from paint booth operations are organic material (as measured by COD) and suspended solids.

Typically the major body paint booths contribute 50 - 75% of the chemical oxygen demand and 40 - 60% of the suspended solids in the total waste load. Therefore, the switch to electrostatic painting could be expected to contribute a 50 - 75% reduction in COD and 40 - 60% reduction in suspended solids.

For stamping plants, no changes in process technology are expected which will reduce the waste volumes.

For stamping plants and assembly plants no changes in process technology are anticipated which will increase the amounts of liquid waste discharges.

In summary, production process changes are not expected to materially affect waste waters produced or the costs of waste treatment for this industry.

B. Treatment Practices

1. The treatment practices applied to stamping operations are quite different than those for body and final assembly operations.

Stamping Plants

For stamping operations, the treatment approach will generally depend upon three factors. The first is whether the contaminated low volume waste water can be conveniently separated from other plant water such as cooling water. The second factor is whether the discharged cooling water requires treatment for removal of contaminants such as chromate which may be added to the cooling water as a corrosion inhibitor. The third factor is whether any soluble oil (emulsified oil) from machining or hydraulic systems can get into the sewer system. For further reference, the potential problem items in this type of discharge are oil (soluble and insoluble), items such as chromate from cooling water, and sometimes suspended solids from powerhouse operations. The following cases represent solutions.

Case I

If soluble (emulsified) oil is not a problem and if the total plant discharge requires treatment either due to an inability to separate the concentrated waste or because the cooling water,

powerhouse water, etc. requires treatment, a typical treatment sequence would be chemical reduction of hexavalent chromium (from recirculating cooling water) followed by a liquid solids separation process such as chemical clarification-skimming or a flotation process for removal of suspended solids, precipitated trivalent chromium, and insoluble oil. This treatment will normally be provided on a flow through basis.

Case II

If the concentrated oil waste (insoluble only) can be separated and if the other water (cooling water, powerhouse water, etc.) does not require treatment, the treatment system can consist of a liquid solids separation process similar to that described above which would usually be operated on a batch basis. Since oil will be the principal contaminant, chromium reduction would not be provided in this case. As an alternate, concentrated oil waste can be incinerated, completely eliminating the material from the waste discharge. Because the actual amount of oil burned is small, the contribution to air pollution from a well designed and operated incinerator is not considered to be significant.

Case III

If there is soluble oil to handle and if the average discharge requires treatment, the treatment sequence will be basically the same as described for Case I except that an additional step for chemically breaking the oil emulsion (usually chemical treatment with a combination of sulfuric acid and a heavy metal ion such as aluminum or iron) will be incorporated in the treatment sequence.

Case IV

If there is soluble oil combined with machine oil in a small volume, the treatment system will essentially be the same as described in Case II except that

provision will be made for chemically breaking the oil emulsion. As an alternate, incineration can be used in this case. For further information refer to Exhibit IX.

The following table will make the following assumptions:

1. Essentially complete removal will be defined as removing the particular contaminant to a level specified for drinking water, as for example reducing hexavalent chromium to 0.05 mg/l or lower.

2. If there is no liquid discharge from the process, as for example incineration, the efficiency will be described as complete. This means that it is complete so far as liquid wastes discharges are concerned.

3. At this point no consideration will be given to handling sludge produced by the waste treatment approaches.

REMOVAL METHOD - Stamping Plants

Normal Efficiency

CASE		Oil	Chromium Hexavalent	Chromium Trivalent	Suspended Solids
I	Treatment of entire discharge (containing no soluble oil) by using chromium reduction & liquid solids separation such as clarification, flotation, etc.	85-95%	Essentially Complete	Essentially Complete	85-95%
II-A	Treatment of concentrated oil (containing no soluble oil) waste separately by liquid solids separation.	75-95%	Not Applicable	Not Applicable	Not Applicable
II-B	Incineration of concentrated oil waste.	Complete	Not Applicable	Not Applicable	Not Applicable
III	Treatment of entire discharge (containing soluble oil) by using chromium reduction, soluble emulsion breaking, and liquid solids separation.	85-95%	Essentially Complete	Essentially Complete	85-95%
IV-A	Treatment of concentrated oil (containing soluble oil) separated by liquid solids separation.	75-95%	Not Applicable	Not Applicable	Not Applicable
IV-B	Incineration of concentrated waste.	Complete	Not Applicable	Not Applicable	Not Applicable

Body and Final Assembly Plants

Body and final assembly plants produce waste water which basically can be described as an organic waste water containing suspended solids. The organic materials originate mainly from paint overspray which is picked up by the water curtain in the paint booth. This is present in the water when the paint booth water is dumped or bled off slowly. Some of the organic material is suspended (paint particles primarily) and some is in solution (mainly paint solvents).

Some organic materials (primarily detergents) can originate from car washing and leak test operations. Additional organic suspended solids (paint particles) can originate from the wet sand deck as can inorganic suspended solids (grinding and sanding materials). Additional contaminants of interest are phosphate, zinc and chromium (hexavalent) from the bonderizing operation.

Assembly plant waste waters are for the most part alkaline, and they can be excessively alkaline when caustic paint strippers are discharged.

It should be noted that some paint strippers contain phenol, although this is not usually considered as a pollution problem in this industry since the trend is toward non-phenol paint strippers, in fact, where phenol has presented a waste water problem the switch to non-phenol strippers has been universal. Additional suspended solids can originate in the powerhouse.

The objectives of treatment of body and final assembly plant wastes are:

1. Adjust the pH.
2. Remove inorganic suspended solids.
3. Remove organic suspended solids.
4. Remove soluble organic material (usually measured as COD or BOD).
5. Reduce the hexavalent chromium to the trivalent form.
6. Remove trivalent chromium.

287-025 O - 68 - 4

Up to the present time virtually no plants have provided for the removal of phosphate. However, for the future, this will, at least in some cases, become a treatment objective. This can be accomplished in a treatment system designed for objectives 1 - 5 but at a significantly increased operating cost.

The conventional treatment sequence is:

1. Flow and contaminant equalization and pH adjustment.
2. Chemical liquid solids separation such as clarification or flotation for suspended solids and heavy metals removal.
3. Conventional biological secondary treatment such as the activated sludge or trickling filter process including sludge settling.
4. Separate collection of chromium containing waste waters for reduction of hexavalent chromium with removal of trivalent chromium in Step 2 above.

The above will be designated as Alternate 1. There are several alternates available. These are:

Alternate 2 - where it is decided not to collect the chromium waste waters separately either of the following can be used:

Alternate 2A - treat chromium waste at the point of equipment discharge.

Alternate 2B - treat the entire waste water discharge for chromium reduction.

Alternate 3 - substitute activated carbon adsorption for biological secondary treatment. To date this has not been practiced in this industry.

Alternate 4 - provide gravity settling for heavy settleable solids ahead of the clarifier. This reduces the suspended solids load to the clarifier or flotation unit and reduces the chemical operating cost. It does not affect the overall treatment efficiency.

For further information see Exhibit X.

In addition to the assumptions made previously for the tables, the following will apply to the next table:

1. While excess alkalinity is an undesirable contaminant, no treatment efficiency will be given for pH adjustment as any desired final pH can be obtained by feeding acid or alkaline materials.

2. Alternate 4 above will not be included in the following table as the overall treatment efficiency in terms of percent removal will be the same as, for example, chemical clarification by itself.

3. Flow and contaminant equalization will not be included in the table as it does not contribute to removal except that it is essential for proper functioning of the waste water treatment facility.

4. Phosphate removal will not be considered except to note that it may, in some cases, have to be removed. The efficiency of the process for phosphate removal can be in the range of 95% if a significantly increased operating cost for chemical coagulants (alum and lime) is absorbed.

5. Organic content will be expressed as chemical oxygen demand (COD) and biochemical oxygen demand (BOD).

Removal Method

ASSEMBLY PLANT
NORMAL REMOVAL EFFICIENCY
BASED ON RAW WASTE WATER
% REMOVED

	COD	BOD	Suspended Solids[3]	Heavy Metals iron, aluminum, zinc	Hexavalent Chromium	Trivalent Chromium
Chromium Reduction	0	0	0	0	Essentially Complete	0
Liquid solids separation such as clarification or flotation to remove organic & inorganic suspended solids	50-60	50-60	85-95	Essentially Complete	0[1]	Essentially Complete
Activated sludge[2] including final settling	35-40	25-45	0[3]	0	0[1]	0
Total efficiency Alternate 1	80-90	85-95	85-95	Essential Complete	Essentially Complete	Essentially Complete
Alternate 2	All efficiencies are the same as Alternate 1					
Alternate 3 Chromium reduction	0	0	0	0	Essentially Complete	0
Liquid solids separation (same as alternate 1)	50-60	50-60	85-95	Essentially Complete	0[1]	Essentially Complete
Activated carbon adsorption	35-45	35-45	3-10	---	---	---
Total efficiency Alternate 3	95	95	95-98	Essentially Complete	Essentially Complete	Essentially Complete

[1] All hexavalent chromium at this point should already be reduced
[2] The trickling filter process can be used in place of the activated sludge process with about the same efficiency.
[3] Except that biological solids from the biological process will be removed in the final settling tank.

2. The above treatment practices have been uniform since 1950. Since new production technology is not expected to introduce major changes in liquid wastes, new technology is not basically required to handle the effluent waste waters discharged through 1977. However, more stringent stream standards may, in some cases, necessitate the use of so called tertiary treatment.

   Carbon adsorption in place of conventional biological treatment is expected to be applied only in limited cases through 1972. By 1977 it may be applied in those cases where a higher quality effluent than is obtainable with conventional biological secondary treatment is needed. It is felt that this will represent no more than 5% of the plants by 1977.*

3. An estimate of the percent of industry waste water discharged to municipal sewers is:

1963	50%
1967	55%
1972	60%

   It is the general feeling of the motor vehicle industry that the desirable approach is to pretreat the waste water on site and then discharge it where possible to a municipal sewage system. Therefore, as these wastes cannot be discharged untreated into water ways, the percent ultimately discharged to municipal systems can be expected to increase, probably to the point that municipal systems will be utilized whenever possible and available.

   For stamping plants the waste waters, after oil and chromium removal if present, present no problems for a municipal system.

* A significant number of plants will discharge to municipal systems and tertiary treatment of the municipal waste may be required in some cases.

It must be borne in mind that assembly plant wastes are basically organic waste water containing suspended solids and basically are compatible with municipal type sewage facilities. However, the high potential pH and presence of heavy metals, particularly chromate, are generally objectionable. Also, the organic content (COD and BOD) is higher than typical municipal sewage as are the suspended solids. Also, the suspended solids (primarily paint particles) can interfere in municipal sludge handling processes (anaerobic digestion for example).

Normally pretreatment will be required for:

1. Heavy metals removal including chromate.
2. Removal of gross suspended solids.

Since a significant portion of the organic material is suspended, removal of suspended solids will effect a reduction in BOD and COD. Such a pretreatment system will consist essentially of the first part of the treatment system discussed previously for equalization, chromium reduction, liquid solids separation, and heavy metal removal. The clarifier or flotation system effluent then is discharged to the municipal treatment system rather than to an on-site secondary biological treatment system.

C. By product utilization is not now a factor in pollution abatement costs, and it is not expected to be a factor over the next decade. A market is not available, nor is there likely to be such a market developed for these materials.

It should be noted that recovered oil is a by-product from many industries. As noted previously, oil is not, in any significant amount, discharged from body assembly and final assembly plants. Oil is the major contaminant from stamping plants, but the amount is generally too small to effect anything but a nominal dollar return from the recovery.

Therefore, by-product recovery and utilization is not considered to be a factor in this industry.

D. Base Year Net Waste Quantities

Exhibit XI indicates the total waste quantities in base year (1963) minus those quantities that would be removed by the normal efficiency of the various treatment methods.

It has already been indicated that by-product utilization is not a factor and is not expected to be for some time due to lack of a market. It has also been indicated that the only new process technology of any potential importance is that of electrostatic painting. It is not anticipated that this will be significantly used for a least 10 years and at that time may only be utilized in new plants.

Therefore, Exhibit XI reveals that the normal treatment methods of chromium reduction, liquids-solids separation and the secondary biological treatment methods (activated sludge, trickling filter, etc.) or carbon adsorption will remove up to 95% of the COD and BOD, up to 97% of the suspended solids and almost all of the hexavalent chromium and heavy metals. This degree of treatment will enable the industry to reduce its pollution load to the streams to 2800 tons of COD, 1500 tons of BOD, 1700 tons of suspended solids and negligible quantities of hexavalent chromium and heavy metals.

E. Projected Net Waste Quantities

Again Exhibit XI indicates the gross waste quantities before treatment projected for each of the years 1968 through 1972 and 1977 minus the quantities reduced by the normal treatment methods so indicated. These final projected net waste quantities reaching the water courses are also projected to increase on the basis of approximately 3% per year. The principal contaminants are COD, BOD and suspended solids totaling by 1977 4800 tons of COD, 2500 tons of BOD and 2800 tons of suspended solids.

IV. WASTE REDUCTION AND REMOVAL COST INFORMATION

A. Based upon data supplied by the industry, and interpreted by us, the replacement value of installed equipment for body and final assembly plants in 1966 was $14,500,000. The comparible figure for stamping plants was $600,000 for a total of $15,100,000.

The estimated operating costs of existing facilities for assembly plants are in the range of $2,500,000 per year and for stamping plants $40,000 a year.

B. Estimated capital and operating costs for assembly plant operations for small, medium and large plants are summarized in Exhibit XII. Estimated capital and operating costs for stamping plants (note that treatment plant costs for this category are generally independent of plant size) are summarized in Exhibit XIII. In all cases, we have assumed a 25 year useful life for waste treatment equipment.

As noted previously, no significant decreases in processing costs are anticipated due to modified technology or by-product recovery over the next decade.

Existing techniques for treatment per se can be applied equally well in an existing plant as compared to a new plant. However, space limitations in existing plants have, in some cases, entailed construction costs of 10 - 20% higher than comparable construction costs where space is not a factor.

In many existing plants, process wastes are collected in combined sewer systems either with sanitary waste or storm water. In almost every case a separate process water collection system is required. The installation of such a collection system in an existing plant can cost between $200,000 and $500,000 with an average of $300,000 for plants of this size.

A separate process collection system can be installed in a plant under construction at a significantly reduced

cost as compared to an existing plant.

The following tables will give a final summary of the cost information based upon 1966 figures. The first table incorporates the capital cost data. Here, the assembly plants were divided into the three categories of small, medium and large based upon production. The cost estimates per plant (Exhibit XII) were then expanded based upon the number of plants in each category giving a total capital cost for assembly plants. The estimated cost of required collection systems (separate process water systems) were then added.

As noted previously, it is anticipated that about 60% of these plants will ultimately discharge to municipal sewer systems after pretreatment. We, therefore, deducted the estimated cost of biological secondary treatment systems that will not be required if these waste waters are sent to municipal systems after pretreatment. We then credited the cost estimate for facilities already installed, giving a total projected capital cost for assembly plants (treatment facility only) of approximately $46,056.00.

For stamping plants, four different treatment approaches were cost estimated (see Exhibit XIII). It is felt that about 25% of the total stamping plants will fall into each category. On this basis the total capital costs were developed. To this figure were added the estimated costs of required process water collection systems, and then the value of already installed equipment was deducted, giving a total required expenditure for this cateogry of approximately $5,500,000 for a total capital figure for automobile plants of approximately $51,500,000. This figure was further expanded to reflect the contribution from truck and bus production yielding a total of approximately $60,000,000. A thirty percent factor for buildings, site operation, engineering etc. was added yielding a total of approximately $77,700,000.

The second table reflects estimated operating costs for assembly and stamping plants. Included in the assembly

plant cost category are the estimated costs of discharging part of these waste waters to municipal systems. The figure is then credited for savings in electric power for secondary treatment systems. The expanded operating cost total for assembly and stamping plants is approximately $13,000,000 per year.

CAPITAL COSTS
1966 BASIS

	Cost	Number of Plants	Total	Subtotals
Assembly Plants				
Small Plants	$ 500,000	8	$ 4,000,000	
Medium Plants	$ 835,000	48	$40,080,000	
Large Plants	$1,370,000	12	$16,440,000	$60,520,000
Cost Of Separate Waste Water Collection System For 30 Plants At $300,000 Per Plant			$ 9,000,000	$69,520,000
Less Credit For Secondary Systems Not Required[2]			$ 8,964,000	$60,556,000
Less Credit For Plants Already Installed			$14,500,000	$46,056,000
Total For Assembly Plants				$46,056,000
Stamping Plants				
Estimated Capital Costs				
Case I	$ 150,000	7[1]	$ 1,050,000	
Case II	$ 175,000	6[1]	$ 1,050,000	
Case III	$ 50,000	6[1]	$ 300,000	
Case IV	$ 60,000	6[1]	$ 360,000	$ 2,760,000
Cost Of Separate Waste Water Collection System For 11 Plants At $300,000 Per Plant			$ 3,300,000	$ 6,060,000
Less Credit For Systems Already Installed			$ 600,000	$ 5,460,000
Total For Stamping Plants				$ 5,460,000
Total For Assembly & Stamping Plant Operations				$51,516,000
Expanded By 1.16 For Trucks & Buses				$59,759,000
Add 30%[3]			$18,000,000	$77,759,000

[1] Assume 25% of plants in each category.

[2] Assume 60% will not be required in each category.

Secondary Costs	Small	$105,000	X	4.8*	=	$ 504,000
	Medium	$200,000	X	28.8*	=	$5,760,000
	Large	$375,000	X	7.2*	=	$2,700,000
						$8,964,000

* No. of Plants

[3] Control Building, Site Preparation, Engineering And Construction Supervision.

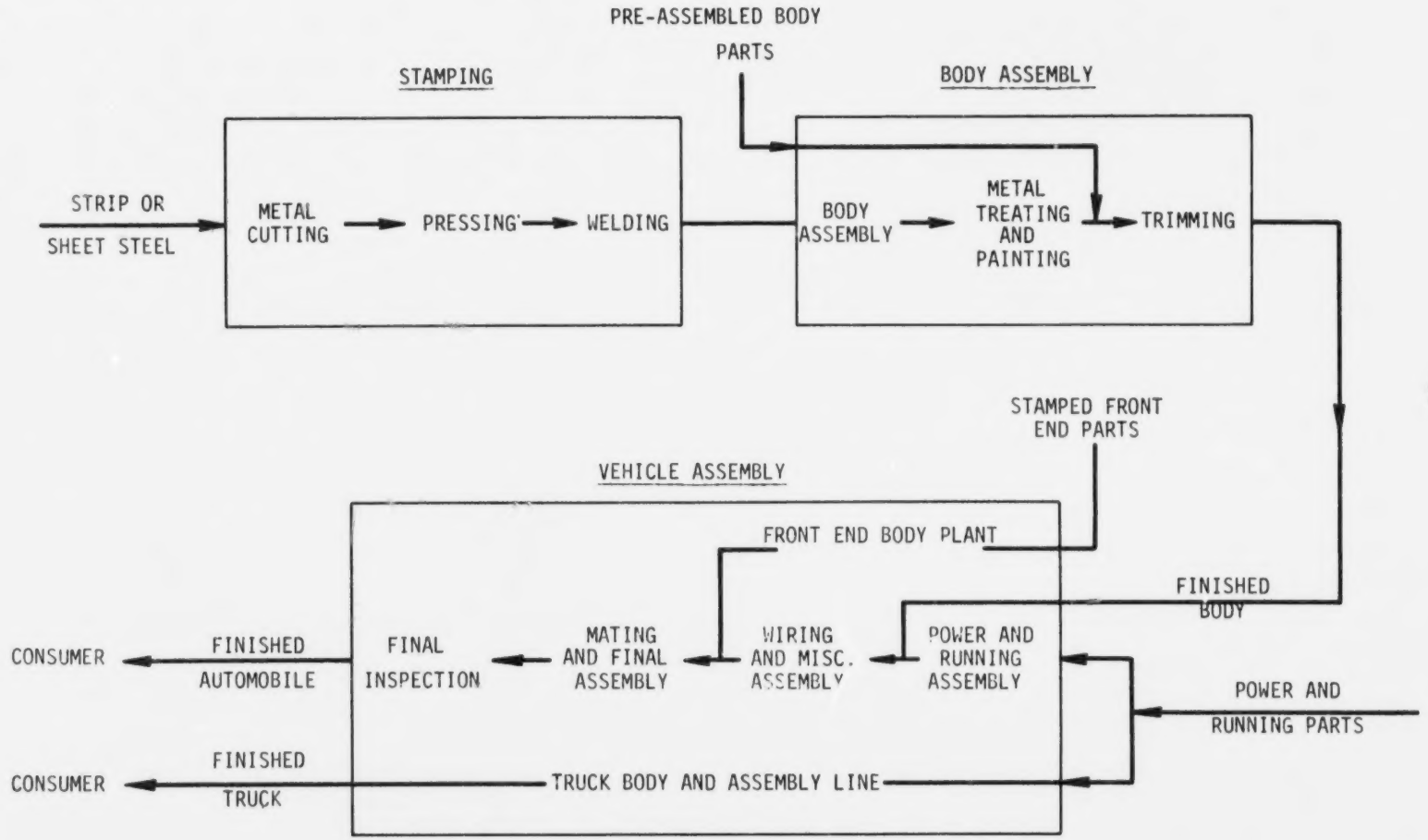
OPERATING COSTS
(300 Days Per Year)
1966 Basis

	Costs $/Year	Number of Plants	Total	Subtotal
Assembly Plants				
Small Plants	$ 47,900	8	$ 383,200	
Medium Plants	$ 80,000	48	$3,873,600	
Large Plants	$149,400	12	$1,792,800	
				$ 6,049,600
Plus Estimated Cost Of Sending Secondary Effluent To Municipal Systems[1]			$5,472,000	
				$11,521,600
Less Savings In Secondary Power Cost			$ 500,000	
Total For Assembly Plants				$11,021,600
				$11,021,600
Stamping Plants				
Estimated Operating Costs				
Case I	$ 14,700	7	$ 102,900	
Case II	$ 17,700	6	$ 106,200	
Case III	$ 7,050	6	$ 42,300	
Case IV	$ 7,800	6	$ 46,800	
Total For Stamping Plants				$ 298,200
				$ 298,200
Total For Assembly And Stamping Plant Operations				$11,319,800
Expanded By 1.16 For Trucks And Buses				$13,130,000

[1]

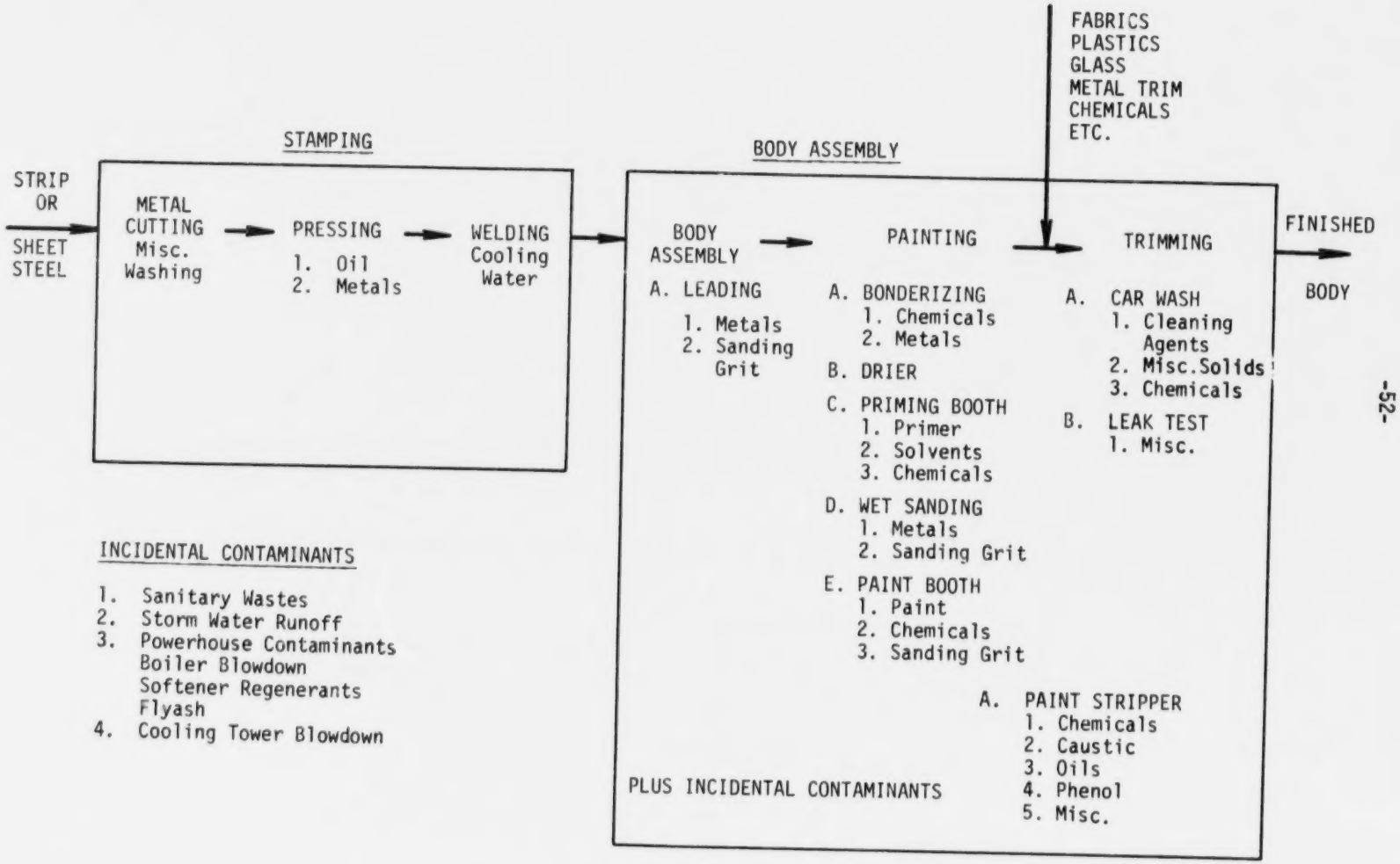
	No. of Plants	gpd	
Small	4.8	1×10^6	4.8×10^6
Medium	28.8	2×10^6	51.6×10^6
Large	7.2	4×10^6	28.8×10^6
Total Flow to Municipal System			91.2×10^6 at $0.20/1000 gal = $18,240/day = $ 5,472,000/year

AUTOMOBILE MANUFACTURING
EXHIBIT I



BODY STAMPING AND ASSEMBLY
SIGNIFICANT POLLUTANTS

EXHIBIT II

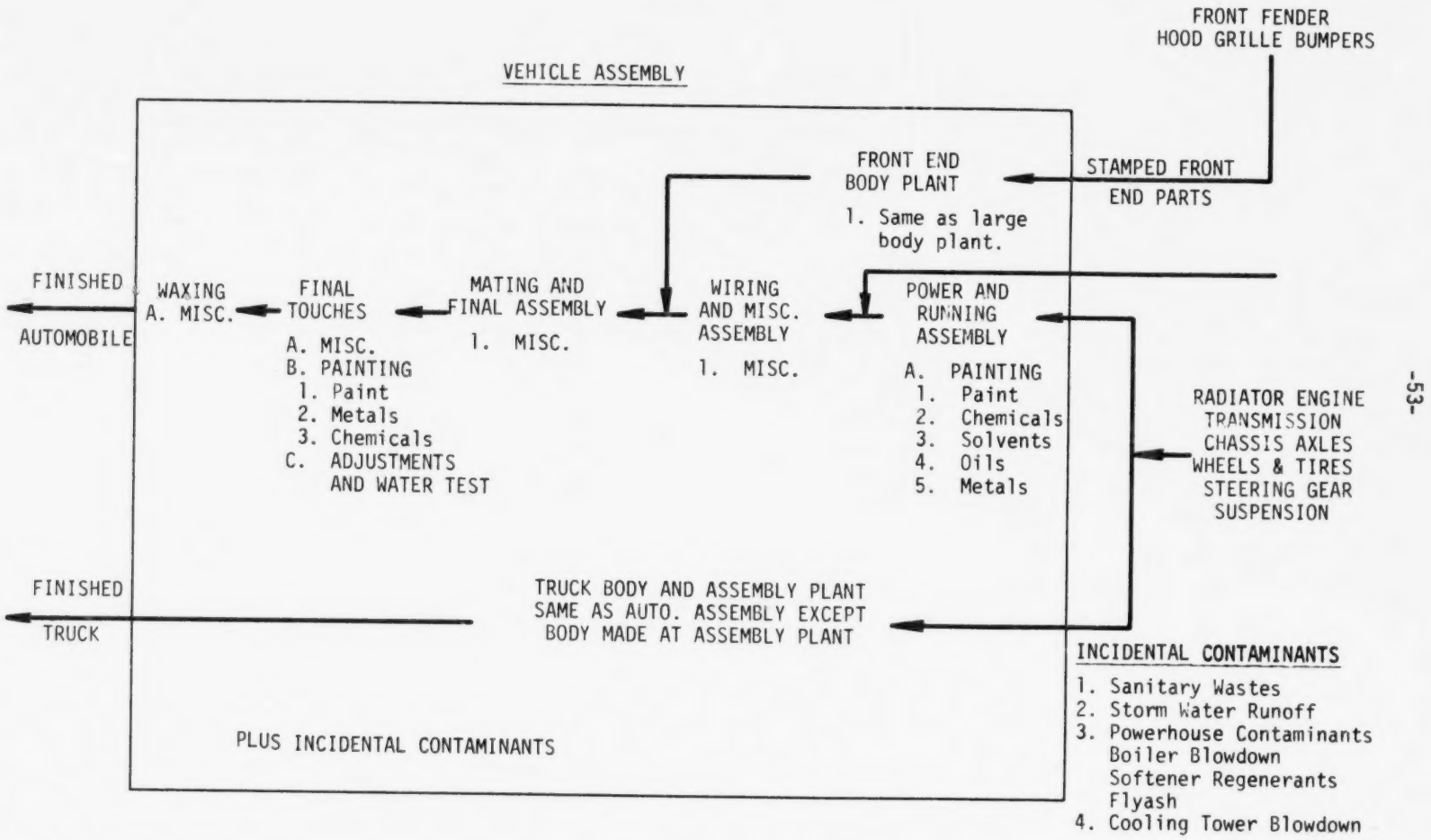


INCIDENTAL CONTAMINANTS

1. Sanitary Wastes
2. Storm Water Runoff
3. Powerhouse Contaminants
   Boiler Blowdown
   Softener Regenerants
   Flyash
4. Cooling Tower Blowdown

VEHICLE ASSEMBLY
SIGNIFICANT POLLUTANTS

EXHIBIT III



BODY ASSEMBLY PLANT
NO. 1
CONTAMINANTS, POUNDS PER 100 BODIES

EXHIBIT IV-A

Process	Tank	Tank Contents	Capacity Gallons	Dump Schedule	Gallons/ 100 bodies	pH	Hydroxide OH	Carbonate CO_2	Bicarbonate HCO_3	Total Acidity as H_2SO_4	Free Mineral Acidity as H_2SO_4	Ortho Phosphate PO_4	Total Chromium CrO_4	COD	Suspended Solids
Bonderite	1	Ridoline 76 Ridosol 250	5,465	1 week	131	8.6	---	0.053	0.865	---	---	0.465	0.008	19.706	1.916
	2	Rinse	2,430	1 day	292	7.1	---	---	0.413	---	---	0.207	0.004	1.850	0.451
	3	Rinse	2,430	1 day	292	6.2	---	---	0.059	---	---	0.159	0.002	1.266	0.401
	4	Granodine 18	4,056	6 mo.	3.7	3.7	---	---	---	0.147	0.016	0.134	NEG.	0.008	0.015
	5	Rinse	2,430	1 day	292	5.4	---	---	0.019	---	---	0.256	NEG.	0.064	0.121
	6	Deoxylyte	2,430	1 day	1,446	4.7	---	---	---	2.772	---	1.506	2.952	0.314	3.010
	7	Deoxylyte	420	No Dump	50	4.7	---	---	---	0.096	---	0.052	0.102	0.011	0.010
Undercoat, 1st Prime	1	Metafloat 62	53,863	1 week	1,295	8.4	---	1.295	15.052	---	---	0.162	1.014	77.687	8.686
	Caustic	Caustic	4,309	1 mo.	24	9.8	2.402	2.884	---	---	---	0.017	0.367	5.494	0.130
Undercoat, 2nd Prime	2	Metafloat 62	53,863	1 week	1,295	8.4	---	1.295	15.052	---	---	0.162	1.014	77.687	8.686
	Caustic	Caustic	4,309	1 mo.	24	9.8	2.402	2.884	---	---	---	0.017	0.367	5.494	0.130
Small Parts Bonderite	1	Durdine 210B	3,500	6 mo.	3.2	5.4	---	---	0.003	---	---	0.145	NEG.	0.045	0.007
	2	Rinse	1,500	1 day	180	6.7	---	---	0.067	---	---	0.037	NEG.	0.029	0.014
	3	Deoxylyte	1,500	1 day	230	4.8	---	---	0.018	---	---	0.153	0.479	0.173	0.018
Lacquer	1	Metafloat 70	46,382	1 mo.	253	6.4	---	---	1.935	---	---	0.002	0.007	19.009	1.352
	2	Metafloat 70	46,382	1 mo.	253	6.4	---	---	1.935	---	---	0.002	0.007	19.009	1.352
	3	Metafloat 70	19,750	1 mo.	108	6.4	---	---	0.824	---	---	0.001	0.003	8.094	0.576
	Caustic 1	Caustic	4,309	6 weeks	17	>10	0.424	0.173	---	---	---	0.002	0.006	3.453	0.069
	Caustic 2	Caustic	4,309	6 weeks	17	>10	0.424	0.173	---	---	---	0.002	0.006	3.453	0.069
	Caustic 3	Caustic	4,309	6 weeks	17	>10	0.424	0.173	---	---	---	0.002	0.006	3.453	0.069
Small Parts Booth	1	Enamel Paint	9,636	2 days	579	8.7	---	0.502	7.055	---	---	0.034	0.084	25.094	6.9001
Deadner Booth	1	Metafloat 70 Undercoat FS-1300	1,077	1 mo.	6	8.8	---	0.023	0.044	---	---	NEG.	NEG.	0.020	0.003
Quarter Panel	1	Metafloat 70	2,633	1 mo.	14	8.9	---	0.042	0.068	---	---	0.003	0.002	0.036	0.005
Water Test Booth	1	Sno-Flake No. 62	9,164	6 weeks	37	6.4	---	---	0.018	---	---	0.001	NEG.	0.101	0.055
Grind & Wire Booth	1	Filings	17,954	1 mo.	98	---	---	---	---	---	---	---	---	---	---

287-025 O - 68 - 5

BODY AND VEHICLE ASSEMBLY PLANT
NO. 2
CONTAMINANTS, POUNDS PER 100 AUTOMOBILES

EXHIBIT IV-8

Process	Tank	Tank Contents	Capacity Gallons	Dump Schedule	Gallons/ 100 Cars	pH	Alkalinity as $CaCO_3$	Acidity as $CaCO_3$	Hex-Chromium as CrO_4	Phosphate PO_4	Flowing Rinses Gallons/ 100 Cars	Total Flow Gallons/ 100 Cars
Body Bonderite	1	Alkali Cleaner	2400	1 Week	71	9.0	Neg.	---	---	---	0	71
	2	Alkali Cleaner	4000	2 Weeks	60	9.0	Neg.	---	---	---	0	60
	3	Hot Water Rinse	2000	1 Day	298	---	Neg.	---	---	---	1440	1738
	4	Hot Water Rinse	2000	1 Day	298	---	Neg.	---	---	---	1440	1738
	5	Zinc Phosphate	2000	1 Day	298	2.5	---	0.372	---	---	0	298
	6	Cold Water Rinse	1300	1 Day	19	---	---	0.004	---	---	1920	1939
	7	Parcolene	1300	1 Day	69	4.0	---	0.010	1.014	0.507	0	69
Sheet Metal (Cars & Trucks)	1	Parco Cleaner	4000	2 Mo.	15	12.0	0.001	---	---	---	0	15
	2	Parco Cleaner	7000	2 Mo.	26	12.0	0.002	---	---	---	0	26
	3	Rinse	3000	2 Days	223	---	Neg.	---	---	---	1440	1663
	4	Rinse	3000	2 Days	223	---	Neg.	---	---	---	1440	1663
	5	Bonderite	4500	1 Day	670	2.5	---	0.838	---	---	0	670
	6	Rinse	2300	2 Days	171	---	---	0.004	---	---	1920	2091
	7	Parcolene	2300	2 Days	221	4.0	---	0.009	0.922	0.461	0	221
Wheel and Small Parts	1	Alkali Cleaner	2500	2 Mo.	9	5.0	Neg.	---	---	---	0	9
	2	Alkali Cleaner	2900	2 Mo.	11	5.0	Neg.	---	---	---	0	11
	3	Rinse	2000	2 Days	149	---	Neg.	---	---	---	1920	2069
	4	Parcolene	2000	2 Days	199	4.0	---	0.008	0.518	0.414	0	199
Cab Washer	1	Alkali	3500	2 Weeks	52	9.0	Neg.	---	---	---	0	52
	2	Hot Water Rinse	1425	1 Day	212	---	Neg.	---	---	---	1920	2132
	3	Zinc Phosphate	1725	1 Day	257	2.5	---	0.321	---	---	0	257
	4	Cold Water Rinse	1425	2 Days	106	---	---	0.002	---	---	1920	2026
	5	Parcolene	1425	2 Days	156	4.0	---	0.006	0.647	0.324	0	156
Small Parts Dulux Washer	1	524	2900	---	---	---	---	---	---	---	0	---
	2	Rinse	2000	---	---	---	Neg.	---	---	---	0	---
	3	Parcolene	2000	2 Days	199	4.0	---	0.008	0.828	0.414	0	199
Floor Pan Washer	1	Alkaline Cleaner	1150	2 Mo.	4	---	Neg.	---	---	---	0	4
	2	Rinse	865	2 Days	64	---	Neg.	---	---	---	384	448
	3	Rinse	865	2 Days	64	---	Neg.	---	---	---	384	448
	4	Zinc Phosphate	1295	1 Day	193	2.5	---	0.241	---	---	0	193
	5	Rinse	662	2 Days	49	---	---	Neg.	---	---	576	625
	6	Parcolene	662	2 Days	99	4.0	---	0.004	0.413	0.207	0	99

VEHICLE ASSEMBLY PLANT

NO. 3

CONTAMINANTS, POUNDS PER 100 AUTOMOBILES

EXHIBIT IV-C

Process	Tank	Tank Contents	Capacity, Gallons	Dump Schedule	Gallons/ 100 Cars	pH	Hydroxide OH	Carbonate CO_3	Bicarbonate HCO_3	Total Acidity as H_2SO_4	Free Mineral Acidity as H_2SO_4	Total Phosphate PO_4	Total Chromium CrO_4	COD	Suspended Solids
Dual Washer Bonderizer	1	Ridoline 49 Ridosol 510	6,050	1 week	145	8.6	---	3.035	1.497	---	---	0.363	0.092	28.176	10.320
	2	Rinse	5,300	1 day	637	8.7	---	0.213	1.100	---	---	0.424	NEG.	6.317	2.124
	3	Ridoline 156	12,100	5 weeks	58	8.4	---	0.005	0.082	---	---	0.079	NEG.	0.424	0.039
	4	Rinse	5,300	1 day	637	8.5	---	0.053	0.064	---	---	0.026	NEG.	0.175	0.028
	5	Granodine 21-C	7,200	6 mo.	6.6	3.0	---	---	---	0.228	0.014	0.003	NEG.	0.002	0.010
	6	Rinse	5,300	1 day	637	8.2	---	---	0.052	---	---	0.064	NEG.	0.172	0.053
	7	Deoxylyte 20	5,300	2 days	1,523	5.2	---	---	0.621	---	---	0.316	0.122	---	0.063
Wheel & Small Parts Washer	1	Metacoat	3,000	5 weeks	14	6.7	---	---	0.180	---	---	1.052	NEG.	7.045	3.504
	2	Metacoat	5,500	5 weeks	26	6.7	---	---	0.027	---	---	1.701	NEG.	1.862	0.204
	3	Rinse	2,400	1 day	268	6.7	---	---	0.098	---	---	0.529	0.004	1.274	0.060
	4	Chromic Acid	2,400	1 day	1,492	3.0	---	---	---	3.010	0.970	0.310	0.663	---	0.186
Passenger Final Process	NW	Kefloc CH	3,000	1 mo.	16	5.7	---	---	0.041	---	---	NEG.	NEG.	0.317	0.019
	SW	Kefloc CH	3,000	1 mo.	16	5.7	---	---	0.041	---	---	NEG.	NEG.	0.317	0.019
Passenger Final Process	NE	Kefloc CH	1,700	1 mo.	9	5.7	---	---	0.023	---	---	NEG.	NEG.	0.180	0.006
	SE	Kefloc CH	1,700	1 mo.	9	5.7	---	---	0.023	---	---	NEG.	NEG.	0.180	0.006
Truck Sheet Metal (Two Tone)	N	Kefloc CH	394	1 week	9	8.3	---	0.012	0.040	---	---	0.003	NEG.	0.041	0.003
	S	Kefloc CH	394	1 week	9	8.3	---	0.012	0.040	---	---	0.003	NEG.	0.041	0.003
Passenger Wheel	N	Kefloc CH	3,275	1 week	79	7.3	---	---	1.170	---	---	0.003	NEG.	0.951	0.567
	S	Kefloc CH	3,275	1 week	79	7.3	---	---	1.332	---	---	0.003	NEG.	0.951	0.567
Truck Sheet Metal	N	Metafloat 64	6,975	1 week	168	8.7	---	0.425	1.770	---	---	0.017	0.005	3.074	0.286
	S	Metafloat 64	6,975	1 week	168	8.7	---	0.425	1.770	---	---	0.017	0.005	3.074	0.286
Cab Dulux	N	Kefloc CH	5,592	1 mo.	31	9.8	---	0.136	0.116	---	---	0.001	NEG.	0.382	0.092
	S	Kefloc CH	5,592	1 mo.	31	9.8	---	0.136	0.116	---	---	0.001	NEG.	0.382	0.092
Passenger Chassis Spray Booth		Metafloat 62	8,652	1 week	207	8.4	---	0.221	0.438	---	---	0.069	0.002	1.780	1.088
Car Underbody Spray Booth		Metafloat 64	2,160	1 week	52	7.0	---	---	0.082	---	---	0.001	0.003	0.068	0.009
Wax Booth		Wax No. VW1317	1,800	1 week	43	7.0	---	---	0.052	---	---	0.001	NEG.	0.122	0.014
Zinc Chromate		Metafloat M-64	2,540	1 week	61	8.7	---	0.086	0.336	---	---	NEG.	0.029	4.579	0.356
Truck Heavy Paint Repair		Kefloc CH	1,550	10 days	19	10.2	0.010	0.056	---	---	---	NEG.	NEG.	0.038	0.011
Passenger Lucite, 1st Pass		Duboise GM64	22,000	1 week	529	5.2	---	---	2.172	---	---	0.132	0.016	25.737	9.122
Passenger Lucite, 2nd Pass		Metasurf 62	8,339	1 week	200	5.2	---	---	0.824	---	---	0.050	0.006	9.756	3.458
Stake Booth		Kefloc CH	3,590	10 days	43	5.5	---	---	0.038	---	---	0.001	NEG.	0.388	0.041
Plastic Parts Console		Metasurf 62	1,750	1 week	42	6.0	---	---	0.083	---	---	0.007	NEG.	2.180	0.682
Cab Touch-Up	N	Metafloat M-64	2,280	1 mo.	12	8.7	---	0.047	0.197	---	---	0.002	NEG.	0.343	0.032
	S	Metafloat M-64	2,280	1 mo.	12	8.7	---	0.047	0.197	---	---	0.002	NEG.	0.343	0.032
Truck Wheel Spray Booth		Kefloc CH	5,780	10 days	69	9.8	---	0.310	0.263	---	---	0.003	NEG.	0.868	0.208
Panel Dulux Spray Booth		Kefloc CH	5,083	1 week	122	9.8	---	0.546	0.462	---	---	0.005	NEG.	1.527	0.366
Truck Chassis Spray Booth		Kefloc CH	8,625	10 days	104	5.5	---	---	0.091	---	---	0.002	NEG.	0.933	0.026
Box Dulux		Metafloat M-64	7,879	10 days	95	8.7	---	0.240	1.000	---	---	0.009	0.003	1.736	0.162
Cab Prime Spray Booth		Kefloc CH	11,612	10 days	140	9.8	---	0.623	0.529	---	---	0.036	NEG.	1.744	0.419
Truck Final Process		Kefloc CH	1,700	10 days	20	10.2	0.010	0.061	---	---	---	NEG.	NEG.	0.047	0.012
Cab Washer	1	Metacoat	2,900	5 weeks	14	6.7	---	---	0.032	---	---	0.256	NEG.	0.361	0.048
	2	Metacoat	3,800	5 weeks	18	6.2	---	---	0.042	---	---	0.335	NEG.	0.473	0.062
	3	Rinse	---	No Dump	1,154	---	---	---	---	---	---	---	---	---	---
	4	Chromic Acid	2,200	1 day	660	3.0	---	---	---	1.333	0.429	0.137	2.036	---	0.083
Caustic Room Q-11	S	Metastrip 25X	3,600	3 mo.	7	10.5	0.074	0.180	---	---	---	0.060	0.172	1.005	0.304
	Middle	Metastrip 25X	2,025	3 mo.	3.7	10.5	0.042	0.101	---	---	---	0.034	0.096	0.566	0.171
	N	Dubois Super Strip	5,625	4 weeks	12	10.5	0.138	0.335	---	---	---	0.113	0.318	1.866	0.564

VEHICLE ASSEMBLY PLANT

NO. 4

CONTAMINANTS, POUNDS PER 100 AUTOMOBILES

EXHIBIT IV-D

Process	Tank	Tank Contents	Capacity Gallons	Dump Schedule	Gallons/ 100 cars	pH	Alkalinity to pH 8.2 as $CaCO_3$	Alkalinity to pH 4.6 as $CaCO_3$	Suspended Solids	Solvent Soluble	Total Acidity as $CaCO_3$	Free Mineral Acidity as $CaCO_3$	Zinc Zn	Nickel Ni	Aluminum Al	hex-Chromium CrO_4	Tri-Chromium CrO_4	Syndet as ABS	Phenol
Body Bonderite	1	Parco 342	2,200	2 weeks	27.5	9.5	0.197	0.596	0.856	0.892	----	----	----	----	----	----	----	----	----
	2	Parco 342	3,600	2 weeks	45	9.6	0.338	1.050	1.928	1.084	----	----	----	----	----	----	----	----	----
	3	Hot Water Rinse	2,200	No Dump	127	9.5	0.439	1.322	1.470	1.205	----	----	----	----	----	----	----	----	----
	4	Hot Water Rinse	2,200	No Dump	127	8.2	----	0.332	0.508	0.307	----	----	----	----	----	----	----	----	----
	5	Bonderite 40	1,560	1 year	1	3.3	----	----	0.012	----	0.018	0.004	0.005	0.003	----	----	----	----	----
	6	Hot Water Rinse	2,200	2 days	138	4.9	----	0.004	0.195	----	----	----	0.026	0.023	----	----	----	----	----
	7	Parcolene 813	2,200	1 mo.	1,264	3.4	----	----	0.482	----	1.353	0.320	----	----	----	0.731	0.108	----	----
Sheet Metal Bonderite	1	Parco 342	8,580	2 weeks	467	9.7	0.936	2.252	1.460	0.913	----	----	----	----	----	----	----	0.004	----
	2	Hot Water Rinse	4,250	No Dump	133	8.5	0.010	0.211	0.244	0.228	----	----	----	----	----	----	----	----	----
	3	Hot Water Rinse	4,250	No Dump	133	5.4	----	0.010	0.067	0.039	----	----	----	----	----	----	----	----	----
	4	Bonderite 40	4,250	1 year	2.7	3.5	----	----	0.009	----	0.075	0.011	0.013	----	0.008	----	----	----	----
	5	Hot Water Rinse	4,330	2 days	271	4.2	----	----	0.361	----	0.237	0.038	0.049	0.051	----	----	----	----	----
	6	Parcolene 813	4,330	1 mo.	1,277	3.1	----	----	0.269	----	0.883	0.369	----	----	----	0.406	0.158	----	----
Chassis Black Booth			81,000	1 mo.	506	9.4	0.966	7.172	1.561	0.485	----	----	----	----	----	----	----	----	----
Quarter Panel Area			30,000	1 mo.	188	7.4	----	0.188	0.024	0.016	----	----	0.027	----	----	0.017	0.009	----	----
Prime Booth	1	Detrex Boothtrol	30,000	1 mo.	188	10.7	2.542	6.406	0.109	0.125	----	----	----	----	----	----	----	----	----
	2	Detrex Boothtrol	30,000	1 mo.	188	10.7	2.542	6.406	0.109	0.125	----	----	----	----	----	----	----	----	----
Wet Deck		Water	*	No Dump	3,000	7.4	----	21.250	37.500	----	----	----	----	----	----	----	----	----	----
Color Booth	1	Detrex Boothtrol	50,000	1 mo.	312	8.4	0.062	9.766	0.638	0.234	----	----	----	----	----	----	----	----	----
	2	Detrex Boothtrol	30,000	1 mo.	188	8.4	0.062	9.766	0.638	0.234	----	----	----	----	----	----	----	----	----
	3	Detrex Boothtrol	30,000	1 mo.	188	8.4	0.062	9.766	0.638	0.234	----	----	----	----	----	----	----	----	----
Paint Strippers	1	Detrex 80A & 539	3,300	2 mo.	10	13.3	16.471	18.859	0.052	0.239	----	----	----	----	----	----	----	0.021	0.075
	2	Detrex 80A & 539	3,300	2 mo.	10	13.1	11.360	15.310	0.566	0.831	----	----	----	----	----	----	----	0.006	0.010

* 200 gpm when in use

BODY ASSEMBLY PLANT AND FINAL ASSEMBLY PLANT
POUNDS OF CONTAMINANTS IN WASTE EFFLUENT

EXHIBIT V

PLANT	BODY ASSEMBLY No. 5		BODY ASSEMBLY No. 1		VEHICLE ASSEMBLY No. 4		VEHICLE ASSEMBLY No. 3		BODY & VEHICLE ASSEMBLY No. 2	
pH	6.4-11.4		6.5-12.3		6.9-9.6		7.0-12.2		6.8	
	POUNDS/DAY	POUNDS/BODY	POUNDS/DAY	POUNDS/BODY	POUNDS/DAY	POUNDS/BODY	POUNDS/DAY	POUNDS/BODY	POUNDS/DAY	POUNDS/BODY
Alkalinity to pH 8.2 as $CaCO_3$	----	----	89	0.11	141.2	0.18	412	0.49	0	0
Alkalinity to pH 4.6 as $CaCO_3$	----	----	455	0.55	1,591.6	1.99	1,056	1.27	500.45	0.74
Nitrate (NO_3)	----	----	----	----	53.0	0.07	----	----	----	----
Suspended Solids	738.7	1.85	819	0.98	363.5	0.45	996	1.20	1,781.08	2.65
Volatile Suspended Solids	----	----	289	0.35	209.4	0.26	682	0.82	----	----
Iron (Fe)	16.2	0.04	35	0.04	8.0	0.01	23	0.03	----	----
Zinc (Zn)	----	----	----	----	11.2	0.01	----	----	----	----
Aluminum (Al)	----	----	11	0.01	1.3	0.001	42	0.05	----	----
Lead (Pb)	----	----	----	----	2.0	0.002	----	----	----	----
Hexavalent Chromium (CrO_4)	2.9	0.007	----	----	17.1	0.02	----	----	0.66	0.001
Trivalent Chromium (CrO_4)	2.0	0.005	----	----	19.0	0.02	----	----	4.42	0.006
Total Chromium (CrO_4)	----	----	15.5	0.02	----	----	33.6	0.04	----	----
Total Organic Carbon	----	----	----	----	531.4	0.66	----	----	600.13	0.89
Chemical Oxygen Demand	2,245.4	5.61	1,093	1.31	833.3	1.04	2,720	3.27	2,500.23	3.72
Biochemical Oxygen Demand	1,349.7	3.37	640	0.77	718.2	0.90	1,452	1.74	550.03	0.82
Solvent Soluble Organic	235.3	0.59	154	0.18	83.4	0.10	477	0.57	412.02	0.61
Phosphate, Ortho (PO_4)	147.0	0.12	50	0.06	----	----	----	----	----	----
Phosphate, Total (PO_4)	----	----	72	0.09	----	----	99	0.12	----	----
Syndet	5.1	0.012	2.2	0.002	----	----	3.7	0.004	----	----
Total Solids	----	----	1,994	2.40	----	----	3,208	3.86	----	----
Volatile Total Solids	----	----	763	0.92	----	----	1,715	2.06	----	----
Flow, gpm	360	----	316	----	324	----	157	----	507	----
Flow, gpd	345,600	----	455,040	----	467,467	----	266,080	----	752,000	----
Flow, gal./body	----	864	----	547	----	584	----	272	----	1,119
Production, bodies/day	400	----	832	----	800	----	832	----	672	----

PROCESS AND EFFLUENT ANALYSIS OF
BODY AND VEHICLE ASSEMBLY PLANTS
MOTOR VEHICLE INDUSTRY

EXHIBIT VI

POUNDS PER 100 BODIES

	Alkalinity to pH 8.2 as $CaCO_3$	Alkalinity to pH 4.6 as $CaCO_3$	Total Acidity as $CaCO_3$	FMA as $CaCO_3$	COD	BOD	Solvent Soluble Organic	Suspended Solids	Volatile Suspended Solids	Total Solids	Volatile Total Solids	CrO_4 Hex	CrO_4 Tri	Total PO_4	Fe	Pb	Al	Zn	Ni	Syndet	Phenol	Gallons/ 100 Bodies
BODY ASSEMBLY																						
I. Total Process Contaminants																						
Plant No. 1	10.8	48.1	---	---	271.5	---	---	34.1	---	---	---	4.6	3.1	3.5	---	---	---	---	---	---	---	57,907
Average of I	10.8	48.1	---	---	271.5	---	---	34.1	---	---	---	4.6	3.1	3.5	---	---	---	---	---	---	---	57,907
II. Effluent																						
Plant No. 1	12.0	50.0	---	---	131.0	77.0	18.0	98.0	35.0	240.0	92.0	1.2	0.8	9.0	4.0	---	1.0	---	---	0.2	---	54,700
Plant No. 5	---	---	---	---	561.0	337.0	59.0	185.0	---	---	---	0.7	0.5	4.0	---	---	---	---	---	1.2	---	86,400
Average of II	12.0	50.0	---	---	346.0	207.0	38.5	142.5	35.0	240.0	92.0	1.0	0.6	6.5	4.0	---	1.0	---	---	0.7	---	70,550
III. Total of I & II	22.8	98.1	---	---	617.5	207.0	38.5	175.6	35.0	240.0	92.0	5.6	3.7	6.5	4.0	---	1.0	---	---	0.7	---	128,457
VEHICLE ASSEMBLY																						
I. Total Process Contaminants																						
Plant No. 2	---	---	1.8	---	---	---	---	---	---	---	---	4.3	---	2.4	---	---	---	---	---	---	---	4,485
Plant No. 3	2.5	20.8	---	---	122.6	---	---	33.2	---	---	---	6.9	4.5	6.1	---	---	---	---	---	---	---	9,726
Plant No. 4	35.2	110.7	---	---	---	---	7.2	49.6	---	---	---	1.2	0.3	---	---	---	0.01	0.1	0.08	0.03	0.08	8,792 *
Average of I	18.9	65.8	1.8	---	122.6	---	7.2	41.4	---	---	---	4.1	2.4	4.2	---	---	0.01	0.1	0.08	0.03	0.08	7,667
II. Effluent																						
Plant No. 2	0	74.0	---	---	372.0	82.0	61.0	265.0	---	---	---	0.1	0.6	---	---	---	---	---	---	---	---	111,900
Plant No. 3	33.0	80.0	---	---	327.0	174.0	57.0	120.0	82.0	386.0	206.0	2.4	1.6	12.0	3.0	---	5.0	---	---	0.4	---	27,200
Plant No. 4	18.0	199.0	---	---	104.0	90.0	10.0	45.0	26.0	---	---	2.0	2.0	---	1.0	0.2	0.1	1.0	---	---	---	58,400
Average of II	17.0	117.7	---	---	267.7	115.3	42.6	143.3	54.0	386.0	206.0	1.5	1.4	12.0	2.0	0.2	2.6	1.0	---	0.4	---	65,834
III. Total of I & II	35.9	183.5	---	---	390.3	115.3	49.8	184.7	54.0	386.0	206.0	5.6	3.8	16.2	2.0	0.2	2.6	1.1	0.08	0.4	0.08	73,501

* Not including Wet Deck

TOTAL WASTE LOAD BASE YEAR (1963)
AND
PROJECTED WASTE LOADS FOR YEARS INDICATED
FOR THE MOTOR VEHICLE MANUFACTURING INDUSTRY

EXHIBIT VII

POUNDS X 10^4

	Alkalinity to pH 8.2 as $CaCO_3$	Alkalinity to pH 4.6 as $CaCO_3$	COD	BOD	Suspended Solids	CrO_4 Hex.	CrO_4 Tri.	Total PO_4	Fe	Al	Zn	Syndet	Gallons X 10^6
I. BODY ASSEMBLY													
1963	208	893	5,620	1,884	1,598	51	34	59	36	9	---	6	11,689
1964	212	912	5,743	1,925	1,633	52	34	61	37	9	---	7	11,946
1965	253	1,089	6,855	2,298	1,949	62	41	72	44	11	---	8	14,259
1966	261	1,122	7,060	2,367	2,008	64	42	74	46	11	---	8	14,686
1967	269	1,156	7,272	2,438	2,068	66	43	76	47	12	---	8	15,128
1968	277	1,191	7,490	2,542	2,130	68	44	78	49	12	---	9	15,581
1969	285	1,228	7,715	2,618	2,194	70	45	80	50	13	---	9	16,049
1970	294	1,265	7,947	2,697	2,260	72	46	82	52	13	---	9	16,530
1971	303	1,303	8,185	2,777	2,327	74	47	85	53	13	---	9	17,026
1972	312	1,342	8,431	2,861	2,397	76	48	88	55	14	---	10	17,536
1973	321	1,382	8,684	2,947	2,470	78	49	91	56	14	---	10	18,063
1974	331	1,424	8,944	3,035	2,543	80	51	94	58	15	---	10	18,605
1975	341	1,467	9,212	3,126	2,620	82	53	97	60	15	---	10	19,163
1976	351	1,511	9,489	3,220	2,698	85	55	100	61	15	---	11	19,740
1977	362	1,556	9,773	3,316	2,701	88	57	103	63	16	---	11	23,300
II. VEHICLE ASSEMBLY													
1963	327	1,670	3,552	1,050	1,681	51	35	147	18	23	10	4	6,688
1964	334	1,707	3,630	1,073	1,718	52	35	151	19	24	10	4	6,835
1965	399	2,037	4,332	1,280	2,050	62	42	180	22	28	12	5	8,159
1966	411	2,098	4,462	1,319	2,112	64	43	185	23	29	13	5	8,403
1967	423	2,161	4,596	1,358	2,175	66	44	191	24	30	13	5	8,655
1968	436	2,226	4,734	1,399	2,240	68	45	197	24	31	14	5	8,915
1969	449	2,293	4,876	1,441	2,308	70	46	203	25	32	14	5	9,183
1970	463	2,362	5,022	1,484	2,377	72	47	209	26	33	14	6	9,458
1971	477	2,433	5,173	1,529	2,448	74	48	215	27	34	15	6	9,742
1972	491	2,506	5,328	1,575	2,522	76	49	222	27	35	15	6	10,034
1973	506	2,581	5,488	1,622	2,598	78	51	229	28	36	16	6	10,335
1974	521	2,658	5,653	1,670	2,675	80	53	236	29	37	16	6	10,645
1975	537	2,738	5,823	1,721	2,755	82	55	243	30	38	17	6	10,964
1976	553	2,820	5,998	1,772	2,838	85	57	250	31	39	17	7	11,293
1977	570	2,905	6,178	1,825	2,923	88	59	256	32	41	18	7	11,632

TOTAL WASTE QUANTITIES & WASTE WATER QUANTITIES
PRODUCED BY THE MOTOR VEHICLE INDUSTRY
(BODY & VEHICLE ASSEMBLY PLANTS)
FOR BASE YEAR 1963 & PROJECTED YEARS

EXHIBIT VIII

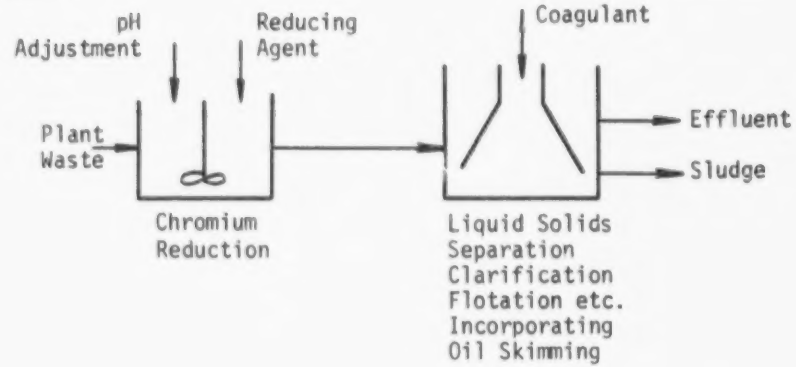
POUNDS X 10^4

	Alkalinity to pH 8.2 as $CaCO_3$	Alkalinity to pH 4.6 as $CaCO_3$	COD	BOD	Suspended Solids	CrO_4 Hex.	CrO_4 Tri.	Total PO_4	Fe	Al	Zn	Syndet	Gallons X 10^6
1963	535	2,563	9,172	2,934	3,279	102	69	206	54	33	10	10	18,377
1968	713	3,417	12,224	3,941	4,370	136	89	275	73	43	14	14	24,496
1969	734	3,521	12,591	4,059	4,502	140	91	283	75	45	14	14	25,232
1970	757	3,627	12,969	4,181	4,637	144	93	291	78	46	14	15	25,988
1971	780	3,736	13,358	4,306	4,775	148	95	300	80	47	15	15	26,768
1972	803	3,848	13,759	4,436	4,919	152	97	310	82	49	15	16	27,571
1977	932	4,461	15,951	5,141	5,624	176	116	361	95	57	18	18	34,932

WASTE TREATMENT METHODS - STAMPING PLANTS

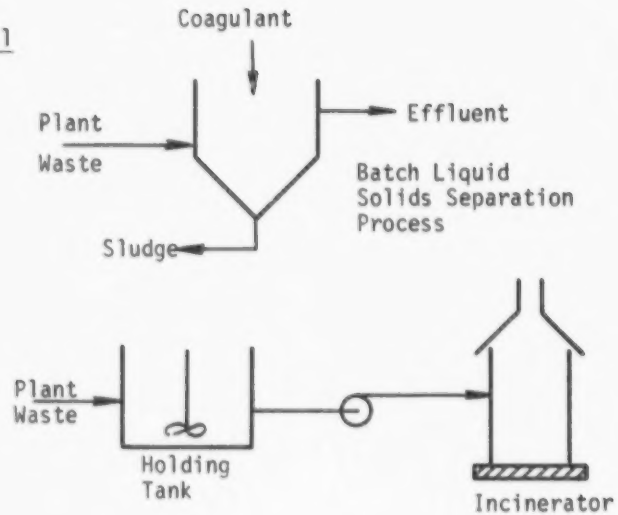
EXHIBIT IX

CASE I



CASE II

Alternate 1



CASE III

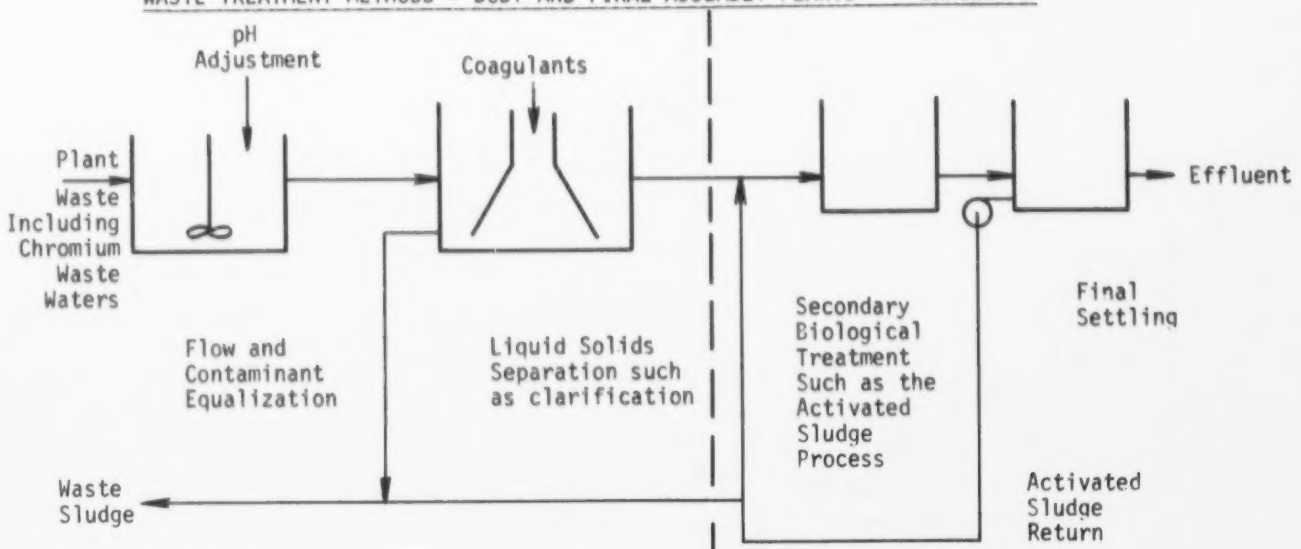
Plant Waste - Same as CASE I except incorporating a treatment step for breaking the soluble oil emulsion.

CASE IV

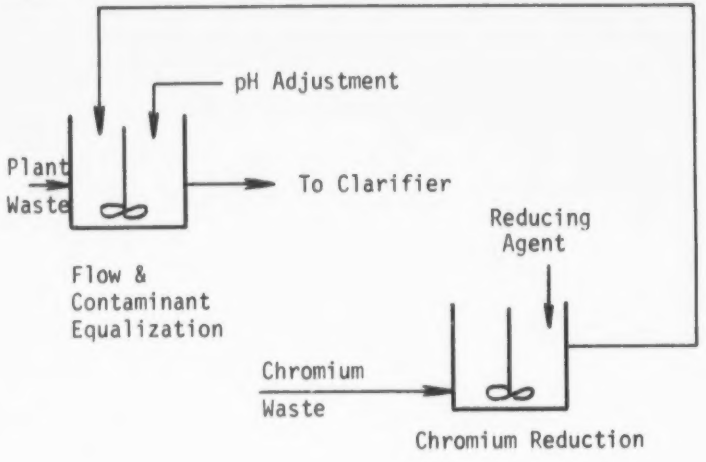
Alternate 1 - Same as CASE II except incorporating provision for breaking the soluble oil emulsion.

Alternate 2 - Same as CASE II.

WASTE TREATMENT METHODS - BODY AND FINAL ASSEMBLY PLANTS - EXHIBIT X



Alternate 1 - Separate Chromium Reduction



Alternate 2

Incorporate gravity settling ahead of equalization and liquid solids separation.

SUMMARY OF BASE YEAR AND PROJECTED NET WASTE LOADS (1963), 1968-1972, AND 1977 FOR THE MOTOR VEHICLE INDUSTRY BODY AND FINAL ASSEMBLY PLANTS

EXHIBIT XI

Period		Gross Waste Quantity Generated (lbs x 10^3)	Percentage of Waste Reduced or Removed by Process Changes, Waste Treatment and By-Products — Percent Removal				Net Waste Quantity Discharged (lbs x 10^3)	
			Case I	Case II	Case III	Case IV	Combinations of Cases I, II & III	Combinations of Cases I, II & IV
			Chromium Reduction	Liquid Solids Separation	Biological Treatment Aeration, Trick. Fil.	Activated Carbon Adsorption	Biological Treatment System	Activated Carbon System
1963	Flow (MGY)	18,377	---	---	---	---	---	---
	COD	7,953	0	55	38	40	567	398
	BOD	2,934	0	55	35	40	293	147
	Suspended Solids	3,461	0	90	---	7	346	104
	Iron	54	0	100	---	0	---	---
	Aluminum	33	0	100	0	0	---	---
	Zinc	10	0	100	0	0	---	---
	CrO_4 (Hex)	102	100	---	---	0	---	---
	CrO_4 (Tri)	69	0	100	---	0	---	---
1968	Flow (MGY)	24,496	---	---	---	---	---	---
	COD	10,600	0	55	38	40	742	530
	BOD	3,941	0	55	35	40	394	197
	Suspended Solids	4,370	0	90	---	7	437	131
	Iron	73	0	100	---	0	---	---
	Aluminum	43	0	100	0	0	---	---
	Zinc	14	0	100	0	0	---	---
	CrO_4 (Hex)	136	100	---	---	0	---	---
	CrO_4 (Tri)	89	0	100	---	0	---	---
1969	Flow (MGY)	25,232	---	---	---	---	---	---
	COD	10,918	0	55	38	40	764	546
	BOD	4,059	0	55	35	40	406	203
	Suspended Solids	4,502	0	90	---	7	450	135
	Iron	75	0	100	---	0	---	---
	Aluminum	45	0	100	0	0	---	---
	Zinc	14	0	100	0	0	---	---
	CrO_4 (Hex)	140	100	---	---	0	---	---
	CrO_4 (Tri)	91	0	100	---	0	---	---
1970	Flow (MGY)	25,988	---	---	---	---	---	---
	COD	11,246	0	55	38	40	787	562
	BOD	4,181	0	55	35	40	418	209
	Suspended Solids	4,637	0	90	---	7	464	139
	Iron	78	0	100	---	0	---	---
	Aluminum	46	0	100	0	0	---	---
	Zinc	14	0	100	0	0	---	---
	CrO_4 (Hex)	144	100	---	---	0	---	---
	CrO_4 (Tri)	93	0	100	---	0	---	---
1971	Flow (MGY)	26,768	---	---	---	---	---	---
	COD	11,583	0	55	38	40	811	579
	BOD	4,306	0	55	35	40	431	215
	Suspended Solids	4,775	0	90	---	7	478	143
	Iron	80	0	100	---	0	---	---
	Aluminum	47	0	100	0	0	---	---
	Zinc	15	0	100	0	0	---	---
	CrO_4 (Hex)	148	100	---	---	0	---	---
	CrO_4 (Tri)	95	0	100	---	0	---	---
1972	Flow (MGY)	27,572	---	---	---	---	---	---
	COD	11,931	0	55	38	40	836	597
	BOD	3,972	0	55	35	40	441	221
	Suspended Solids	4,919	0	90	---	7	492	148
	Iron	82	0	100	---	0	---	---
	Aluminum	49	0	100	0	0	---	---
	Zinc	15	0	100	0	0	---	---
	CrO_4 (Hex)	152	100	---	---	0	---	---
	CrO_4 (Tri)	97	0	100	---	0	---	---
1977	Flow (MGY)	34,932	---	---	---	---	---	---
	COD	13,831	0	55	38	40	960	692
	BOD	5,141	0	55	35	40	514	257
	Suspended Solids	5,624	0	90	---	7	562	169
	Iron	95	0	100	---	0	---	---
	Aluminum	57	0	100	0	0	---	---
	Zinc	18	0	100	0	0	---	---
	CrO_4 (Hex)	176	100	---	---	0	---	---
	CrO_4 (Tri)	116	0	100	---	0	---	---

CAPITAL COSTS AND ANNUAL OPERATING EXPENDITURES ASSOCIATED WITH WASTE WATER VOLUMES FOR BODY AND ASSEMBLY PLANTS

EXHIBIT XII

TYPICAL TECHNOLOGY	CAPITAL EXPENDITURES: TREATMENT PROCESS	COSTS ($X10^3)	ANNUAL OPERATING & MAINTENANCE EXPENDITURES: ITEM	COSTS ($X10^3)	ECONOMIC LIFE
SMALL PLANT FLOW = 1 MGD (560 Cars/day)	BOD = 192 ppm Iron = 3.6 ppm Zn = 0.7 ppm CrO_4 (Hex) = 2.7 ppm COD = 520 ppm S.S. = 220 ppm Al = 2.1 ppm CrO_4 (Tri) = 1.2 ppm				
ACTIVATED SLUDGE AND COMBINED CHROMIUM REDUCTION SYSTEM (REFER TO DIAGRAM)	Preliminary	80.0	CHEMICALS		
	Primary Clarification	60.0	1. $FeSO_4$	1.11	
	Second. Treatment	105.0	2. Polymers, Coagulant Aids, etc.	8.00	
	Sludge Treatment	135.0	LABOR	20.00	25 YEARS
	Misc. (Process plumb., elec., etc.)	70.0	MAINTENANCE & REPAIRS	2.00	
			MATERIALS & SUPPLIES	2.00	
			POWER	6.00	
	TOTAL CAPITAL COSTS	450.0	TOTAL OPERATING COSTS	39.11	25 YEARS
ALTERNATE 1 SEPARATE CHROMIUM REDUCTION PLUS ACTIVATED SLUDGE (REFER TO DIAGRAM)	Preliminary	110.0	CHEMICALS		
	Primary Clarification	60.0	1. $FeSO_4$	1.05	
	Second. Treatment	105.0	2. Polymers, Coagulant Aids, etc.	8.00	
	Sludge Treatment	135.0	3. SO_2	6.75	
	Misc. (Process plumb., elec., etc.)	90.0	4. Lime	2.10	25 YEARS
			LABOR	20.00	
			MAINTENANCE & REPAIRS	2.00	
			MATERIALS & SUPPLIES	2.00	
			POWER	6.00	
	TOTAL CAPITAL COSTS	500.0	TOTAL OPERATING COSTS	47.90	25 YEARS
ALTERNATE 2 PRESEDIMENTATION AND ACTIVATED SLUDGE (REFER TO DIAGRAM)	Preliminary	100.0	CHEMICALS		
	Primary Clarification	60.0	1. $FeSO_4$	0.65	
	Second. Treatment	105.0	2. Polymers, Coagulant Aids, etc.	5.00	
	Sludge Treatment	135.0	LABOR	20.00	25 YEARS
	Misc. (Process plumb., elec., etc.)	80.0	MAINTENANCE & REPAIRS	2.00	
			MATERIALS & SUPPLIES	2.00	
			POWER	6.00	
	TOTAL CAPITAL COSTS	480.0	TOTAL OPERATING COSTS	35.65	25 YEARS
MEDIUM PLANT (1000 cars/day) Flow = 2.0 MGD (SAME CONCENTRATIONS AS SMALL PLANT)					
ACTIVATED SLUDGE AND COMBINED CHROMIUM REDUCTION SYSTEM (REFER TO DIAGRAM)	Preliminary	120.0	CHEMICALS		
	Primary Clarification	90.0	1. $FeSO_4$	2.20	
	Second. Treatment	200.0	2. Polymers, Coagulant Aids, etc.	16.00	
	Sludge Treatment	250.0	LABOR	25.00	25 YEARS
	Misc. (Process plumb., elec., etc.)	105.0	MAINTENANCE & REPAIRS	4.00	
			MATERIALS & SUPPLIES	4.00	
			POWER	12.00	
	TOTAL CAPITAL COSTS	765.0	TOTAL OPERATING COSTS	63.20	25 YEARS
ALTERNATE 1 SEPARATE CHROMIUM REDUCTION PLUS ACTIVATED SLUDGE (REFER TO DIAGRAM)	Preliminary	160.0	CHEMICALS		
	Primary Clarification	90.0	1. $FeSO_4$	2.00	
	Second. Treatment	200.0	2. Polymers, Coagulant Aids, etc.	16.00	
	Sludge Treatment	250.0	3. SO_2	13.50	
	Misc. (Process plumb., elec., etc.)	135.0	4. Lime	4.20	25 YEARS
			LABOR	25.00	
			MAINTENANCE & REPAIRS	4.00	
			MATERIALS & SUPPLIES	4.00	
			POWER	12.00	
	TOTAL CAPITAL COSTS	835.0	TOTAL OPERATING COSTS	80.70	25 YEARS
ALTERNATE 2 PRESEDIMENTATION AND ACTIVATED SLUDGE (REFER TO DIAGRAM)	Preliminary	145.0	CHEMICALS		
	Primary Clarification	90.0	1. $FeSO_4$	1.30	
	Second. Treatment	200.0	2. Polymers, Coagulant Aids, etc.	10.00	
	Sludge Treatment	250.0	LABOR	25.00	25 YEARS
	Misc. (Process plumb., elec., etc.)	120.0	MAINTENANCE & REPAIRS	4.00	
			MATERIALS & SUPPLIES	4.00	
			POWER	12.00	
	TOTAL CAPITAL COSTS	805.0	TOTAL OPERATING COSTS	56.30	25 YEARS
LARGE PLANT (2000 cars/day) Flow = 4.0 MGD (SAME CONCENTRATIONS AS SMALL PLANT)					
ACTIVATED SLUDGE AND COMBINED CHROMIUM REDUCTION SYSTEM (REFER TO DIAGRAM)	Preliminary	180.0	CHEMICALS		
	Primary Clarification	135.0	1. $FeSO_4$	4.40	
	Second. Treatment	375.0	2. Polymers, Coagulant Aids, etc.	24.00	
	Sludge Treatment	450.0	LABOR	40.00	25 YEARS
	Misc. (Process plumb., elec., etc.)	360.0	MAINTENANCE & REPAIRS	8.00	
			MATERIALS & SUPPLIES	8.00	
			POWER	24.00	
	TOTAL CAPITAL COSTS	1,300.0	TOTAL OPERATING COSTS	108.40	25 YEARS
ALTERNATE 1 SEPARATE CHROMIUM REDUCTION PLUS ACTIVATED SLUDGE (REFER TO DIAGRAM)	Preliminary	230.0	CHEMICALS		
	Primary Clarification	135.0	1. $FeSO_4$	4.00	
	Second Treatment	375.0	2. Polymers, Coagulant Aids, etc.	30.00	
	Sludge Treatment	450.0	3. SO_2	27.00	
	Misc. (Process plumb., elec., etc.)	180.0	4. Lime	8.40	25 YEARS
			LABOR	40.00	
			MAINTENANCE & REPAIRS	8.00	
			MATERIALS & SUPPLIES	8.00	
			POWER	24.00	
	TOTAL CAPITAL COSTS	1370.0	TOTAL OPERATING COSTS	149.40	25 YEARS
ALTERNATE 2 PRESEDIMENTATION AND ACTIVATED SLUDGE (REFER TO DIAGRAM)	Preliminary	210.0	CHEMICALS		
	Primary Clarification	135.0	1. $FeSO_4$	2.50	
	Second Treatment	375.0	2. Polymers, Coagulant Aids, etc.	20.00	
	Sludge Treatment	450.0	LABOR	40.00	25 YEARS
	Misc. (Process plumb., elec., etc.)	170.0	MAINTENANCE & REPAIRS	8.00	
			MATERIALS & SUPPLIES	8.00	
			POWER	24.00	
	TOTAL CAPITAL COSTS	1,340.0	TOTAL OPERATING COSTS	102.50	25 YEARS

COSTS FOR STAMPING PLANT WASTE SYSTEMS

EXHIBIT XIII

CASE I - End of line treatment facility with no provision for handling soluble oil.

CASE II - End of line treatment system with provision for handling soluble oil.

CASE III - Concentrated waste treatment system with no provision for handling soluble oil.

CASE IV - Concentrated waste treatment system with provision for handling soluble oil.

	ESTIMATED CAPITAL COSTS EXCLUDING COLLECTION SYSTEM
CASE I	$150,000
CASE II	$175,000
CASE III	$ 50,000
CASE IV	$ 60,000

	ESTIMATED OPERATING COST FOR CHEMICALS, MAINTENANCE, OPERATING MANPOWER, AND ELECTRICAL POWER
	$/Year
CASE I	$14,700
CASE II	$17,700
CASE III	$ 7,050
CASE IV	$ 7,800

PARTS AND ACCESSORIES

I. PROCESSES AND WASTES

A. Description of Processes and Pollutants

In view of the total number of parts included in a completely assembled automobile, it is apparent that these represent a tremendous number of individual manufacturing operations.

However, in reviewing these parts and operations from the viewpoint of the type of water-borne contaminants produced, this multiplicity of operations and parts can be divided into a set of simplified and therefore very generalized operations. The major subdivision is between those operations that primarily result in the discharge of an oil contaminated water and those operations that result in the discharge of a water whose major contaminant is not oil.

The following table generally describes the fundamental assembly processes, beginning materials, product and pollutants of each major operation:

I. MANUFACTURING PROCESSES PRODUCING PRIMARILY OIL-CONTAINING WASTES

Raw or Beginning Materials	Fundamental Processes	Final Product	Pollutants
Machining[1]			
1. Blank	Machining	Machined Part	Oil, Iron Chips, Suspended Solids
2. Machined Part	Cleaning & Re-oil	Finished Part	Oil, Phosphate, Caustic, Iron
Die Casting[2]			
1. Molten Metal	Casting	Cast Part	Oil
2. Cast Part	Water Quench	Cast Part	Metal Chips
3. Cast Part	Trimming & Buffing	Finished Part	Oil, Metal Chips
Wheel Manufacture[3]			
1. Raw Steel	Pickling	Pickled Steel	Acid, Iron, Suspended Solids
2. Pickled Steel	Cutting, Shaping & Welding of Rim & Spider Assembly	Completed Components	Oil, Suspended Solids
3. Completed Components	Assembly	Assembled Wheel	----------
4. Assembled Wheel	Bonderizing	Bonderized Wheel	Chromate, Phosphate Alkali, Acid, Solids, Detergent, Oil
5. Bonderized Wheel	Painting	Finished Wheel	Suspended Solids, Organic

[1] Refer to Exhibit I
[2] Refer to Exhibit II
[3] Refer to Exhibit III

II. MANUFACTURING PROCESSES PRODUCING WASTES PRIMARILY NOT CONTAINING OIL

Raw or Beginning Materials	Fundamental Processes	Final Product	Pollutants
Metal (Sand) Casting[1]			
1-a Sand	Washing & Formation of Cast	Cast	Solids, Organic, Color
1-b Metal	Foundry	Molten Metal	Suspended Solids
2.Molten Metal	Casting & Washing	Finished Part	Solids, Iron, Color
Plating[2]			
1. Metal Part	Cleaning	Cleaned Part	Wetting Agents, Acid, Alkali
2. Cleaned Part	Copper Plate	Copper Plated Part	Cyanide, Alkali, Copper
3. Copper Plated Part	Nickel Plate	Nickel Plated Part	Acid, Nickel
4. Nickel Plated Part	Chromium Plate	Finished Part	Acid, Chromate
Radiator Manufacture[3]			
1. Raw Copper & Brass	Rolling	Core & Tank Assemblies	Metals, Oil
2. Core & Tank Assemblies	General Assembly	Assembled Radiator	Chemicals, Metals, Misc.
3. Assembled Radiator	Radiator Flush	Cleaned Radiator	Acid, Metals
4. Cleaned Radiator	Testing & Painting	Finished Radiator	Paint, Chemicals, Solvents, Misc.

1 Refer to Exhibit IV
2 Refer to Exhibit V
3 Refer to Exhibit VI

287-025 O - 68 - 6

Raw or Beginning Materials	Fundamental Processes	Final Product	Pollutants
Battery Manufacture[4]			
1. Grid & Lead Sulfate Paste	Bonding	Completed Plate	Lead
2. Plate & Other Components	Assembly	Assembled Battery	-------
3. Assembled Battery	Formation & Washing	Finished Battery	Sulfuric Acid
Air Conditioner Manufacture[5]			
1. Raw Rolled Metal	Parts Formation	Components	Metals, Misc.
2. Components	Sub Assembly	Sub Assembled Unit	Chemicals, Misc.
3. Sub Assembled Unit	Joining	Assembled Unit	Metals, Chloride
4. Assembled Unit	Cleaning & Bonderizing	Cleaned Unit	Acid, Chromium
5. Cleaned Unit	Painting	Finished Air Conditioner	Paint, Chemicals, Solvents
Plastic Part Manufacture[6]			
1. Purchased Material	Extruding or Casting	Extruded Part	---------
2. Extruded Part	Trimming & Painting	Finished Part	Paint

[4] Refer to Exhibits VII-A & VII-B
[5] Refer to Exhibit VIII
[6] Refer to Exhibit IX

Raw or Beginning Materials	Fundamental Processes	Final Product	Pollutants
Rubber Parts Manufacture[7]			
1. Raw Materials	Banbury Mixer	Raw Rubber	Solids, Color, Soap
2. Raw Rubber	Cooling & Milling	Finished Rubber	Solids, Color, Soap, Oil
3. Rubber	Tire Assembly, Tuber or Extruder	Assembled Part	--------
4. Assembled Part	Fabrication & Curing	Finished Part	--------
Windshield Manufacture[8]			
1-a Plastic	Stretching, Cutting, Washing	Plastic Component	Negligible
1-b Plate Glass	Cutting & Bending	Glass Components	Negligible
2. Plastic & Glass Pieces	Assembly	Assembled Windshield	---------
3. Assembled Windshield	Washing	Finished Windshield	Negligible

[7] Refer to Exhibit X
[8] Refer to Exhibit XI

B. Significant Pollutants

The significant pollutants associated with the motor vehicle parts manufacturing industry cover a wide variety. However, we have divided this industry into segments based on primary contaminant produced in manufacturing various types of products. These are as follows:

1. Parts Manufacturing Operations Producing Primarily Oil Containing Wastes.

The operations included in this category are as follows:

a. Machining Operations

The blank part, which may have been produced elsewhere, is subjected to a machining operation. Soluble oils are liberally applied to the blank during this phase to facilitate the cutting operation. This finished piece can then be cleaned and re-oiled to prevent surface corrosion until it is ready for use.

Oil is introduced in water as a result of the cleaning operation. Incidental spillage of oil also will occur, and this may be discharged into the sewer system during plant cleaning operations. Also, the emulsified oil systems must be periodically dumped and cleaned. Some of the oil contamination is a function of number of units produced. Other sources are quite indeperdent of the number of units produced. Small amounts of phosphate, metals, caustic and solids may be produced in this operation.

b. Die Casting Operations

In this process molten metal is transferred to the casting machine where it is molded into a desired shape. The molded product is discharged from the casting machine into a water

quench pit, from which it is removed by conveyors. Excess metal is trimmed from the product after which it may be buffed. Additional surface treatment such as plating may be applied, but this depends on the product.

The major contaminant that may be discharged from this operation is oil in the cooling water. Whether this constituent is present in major proportion depends to a great extent on how the machines are operated and maintained. The other contaminant is metal chips or solids from the buffing operation. Metal chips normally settle out in the quench pit, from which they are manually removed, so they normally do not contribute to the plant effluent. In the buffing operation, wet air scrubbers are used to remove suspended particles from the air, and this water must be dumped periodically. Contamination from this process is generally independent of the units produced.

c. Wheel Manufacturing

The first step in the manufacture of wheels is the pickling of the raw steel. The steel is cut and shaped into two assemblies, the rim of the wheel and the spider assembly. These two components are then combined in the next operation. The assembled wheel is bonderized to prevent rusting during consumer use and is painted. The finished wheel is ready for use at this point.

The major contaminants produced from these manufacturing operations are oils. Soluble oil is used as a lubricant and cooling agent during the shaping operations. These oils must be periodically dumped. Therefore, contaminants from these operations are generally independent of the number of units produced. Other contaminants produced from these

operations are chromate, acid, alkali, solids and detergents.

2. Processes Producing Primarily Non-Oil Contaminants

Those parts manufacturing processes which produce primarily waste water other than oil are as follows:

a. Metal (Sand) Casting Operations

The sand is washed and is then mixed with rosin, starch or other forming materials. The sand mixture is placed in a form and packed around a pattern of the object to be cast. The pattern is removed and hot metal from the foundry is poured into the sand casting. This is then allowed to cool. After cooling, the sand is removed and the metal piece goes to a shakeout operation where most of the sand is removed. The finished piece may be cleaned using high pressure water or air. The finished, cleaned piece then goes to a machining or assembling operation. The sand from the shakeout operation may be hydraulically washed, reclassified and returned to the mold preparation area, or it may be discharged to waste as a slurry.

The primary contaminant dishcarged from this operation is suspended solids. Organic material from the binders and rosin may present biochemical oxygen demand and color problems of varying degrees of magnitude.

b. Plating Operations

Many automobile parts (grilles, bumpers, interior and exterior trims) are plated parts. In a plating process, the unfinished metal part first goes through a cleaning cycle which prepares the metal for plating. The part is then dipped successively in a copper plating

solution, a nickel plating solution and finally in a chromium plating solution. After drying the finished plated part is ready for use.

The primary contaminants from the process are alkali, acids, cyanide and heavy metals, such as copper, nickel and chromium. The amount of waste produced is a function of the number of pieces of the same type plated. The specific contaminant load per piece is due to dragout from the plating or processing bathes, and this varies with the shape of the piece.

c. Radiator Manufacturing

Copper and brass are received and rolled to the proper thickness. The metal is formed into cores and headers. These units are assembled into the radiators. The completed radiator is flushed with acid to clean out residual metal and solder, after which it is rinsed to remove the free acid. The units are inspected and tested to insure that there are no leaks. The cleaned unit is then painted.

Major contaminants from this process are acid and heavy metals such as copper and zinc. If the plant rolls the metal to the desired thickness, oil will be present as from any metal rolling operation. The wastes from the paint operation are solids and solvents, and these are a function of the number of units produced. This can vary, however, depending on the shape of the finished product.

d. Battery Manufacturing

In the production of automobile batteries, the first steps are the formation of the grid and the production of the lead sulfate paste which eventually will be bonded to the grid.

Lead oxide, water and sulfuric acid are combined to form the lead sulfate paste. An alloy of mainly lead and antimony is used for the grid. The grid is formed in a casting operation. The next step in the production process is the bonding of the lead sulfate paste onto the grid. The completed grid is then dried. The plates or grids are next assembled into positive and negative groups. The positive and negative plates are interleaved with separators, which are usually rubber, to form the element. The element is then placed in the container, the cover is sealed on, the cells are joined with the top connectors and the completed battery assembly is sealed. The final step in this operation is the formation (charging) of the battery with sulfuric acid. The battery is filled with sulfuric acid. The acid is drained out, and the battery is washed. The battery is again filled with sulfuric acid and is ready for use.

About one half of the batteries manufactured are "dry" batteries. The production process for dry batteries is exactly the same as that for wet batteries up to the charging operation. The battery is filled with sulfuric acid. The acid is drained out, and the battery is washed and dried. At this point the battery is ready for shipment to the consumer. When the battery is ready to be used, it is filled with sulfuric acid.

The main contaminants produced from this operation are sulfuric acid and lead. The acid is from the expansion and overflow of acid during the initial charging operation and the necessity of washing the cases prior to packaging. Some acid spills occur during filling and emptying operations. The lead is generated from the paste and general operational procedures. Therefore, the waste load from a given plant is a function of the

number of units produced but is not dependent on a planned production step.

e. Air Conditioner Unit Manufacturing

The first step in the manufacture of automobile air conditioners is the formation of the raw rolled metal into various component parts. The parts are combined into subassemblies which are then joined or welded together into the complete unit. The unit is rinsed, cleaned and bonderized to prevent corrosion during use. The finished unit may be painted before being packaged and shipped.

The contaminants produced in this operation are acid, heavy metals, such as aluminum and chromate, and fluoride. The amount of contaminants produced is a function of the number of units produced in a given plant using a specified process.

f. Plastic Parts Manufacturing

An increasing number of automobile parts such as tail lights, exterior trim and instrument panel components are being manufactured from plastic. In a plant producing such parts raw plastic material is purchased from a basic plastic producer. The raw material is formed into the part being produced by an extruding or casting operation. After the part is trimmed and painted, it is ready for use.

A small number of such plastic parts are plated. In the plating process the part is first dipped into an electrolysis copper solution. After it is copper plated, it is nickel plated and finally chromium plated. The finished part is then ready for shipment.

Wastes discharged from these operations come from the painting or plating operation. These are solids, solvents, copper, acid, nickel

and chromium. The amount of waste produced per unit of production will vary with the shape of the part and the degree or type of finish applied.

g. Rubber Products Manufacturing

The raw materials (natural or synthetic rubber, carbon black, sulfur and other chemicals) are blended in a Banbury mixer. The blended rubber passes from the Banbury mixer in either pellet or slab form. Soapstone solution (a mixture of clay, soap and water) is sprayed on both the pellets and slabs. The pellets would go to another Banbury or mill for further mixing while the slabs pass to a cooling conveyer for cooling and cutting into specific lengths. The slabs then pass to a series of mills and strainers for further refining. At this point, the refined rubber can go to a number of different processes depending on the final product.

The green tire is formed by fabricating the tread and sidewall with the ply materials, white wall and bead. The green tire is cured and is pressure cooled. From this point, the black wall tires go to storage. The white wall tires pass to a grinding operation for removal of the black layer from the white wall; the white wall is sprayed for protection; the tire is wrapped and then goes to storage.

For hose or inner tube production, the refined rubber passes to a tuber. Both are produced in basically the same manner--fabrication, curing and storage. Also, refined rubber can go to an extrusion process for the manufacture of molding, wiper blades, fan belts and other extruded products. This involves fabrication, curing and storage steps.

The primary contaminant from this process is solids. Some organic material may be introduced

into the waste during the curing process. The major pollutants do not appear to be directly related to the number of units produced.

h. Windshield Manufacturing

An automobile windshield is composed of two pieces of plate glass and one piece of plastic. In the manufacturing process, two pieces of plate glass (which are not produced at the windshield manufacturing plant) are first cut to the proper size. After being heated, the two pieces of glass are bent simultaneously. In a separate operation plastic (which also has been produced outside of the windshield manufacturing plant) is stretched, cut to the proper size and washed. If it is to be a tinted windshield, the plastic is tinted in this operation. After the bent pieces of glass have cooled, the plastic piece is manually inserted between the two glass pieces. A vacuum is applied and the glass pieces and the plastic piece are fused together using heat. When the unit has cooled, pressure is applied to make the plastic completely transparent. The finished windshield after a final wash is then ready for shipment and use.

This is basically a dry operation. Little or no contaminants are discharged from this operation.

There are other waste streams connected with these parts manufacturing operations that contribute incidental contaminants. These waste streams are:

1. Sanitary Wastes
2. Storm Water Runoff
3. Powerhouse Contaminants
   (Boiler Blowdown, Softener Regenerants, Flyash)
4. Cooling Tower Blowdown

C. In the accepted sense of the word, only a small percentage of the process water is reused in these various manufacturing operations. For example, a plant may circulate the chromium containing rinse water through a demineralizer for recovery of the chromium, and the water is returned for re-use.

Some re-use systems have been installed on the basis of collecting once-through cooling water and re-using it as process water.

Recirculating cooling water systems are used in more and more plants in this industry. It has been estimated that water usage for this industry would be doubled if cooling water recirculation was not being used in the plants.

D. In this segment of industry, which involves some 1700 plants, there is not only the difference in manufacturing methods used to produce a given part but basic differences in the number and variety of parts made at any one facility. Meaningful compilation of this information may be impossible. Significantly more data would be required before it could even be attempted.

E. Plant subprocesses producing particularly difficult waste problems are generally confined to:

1. Plating operations
2. Emulsified oil
3. Metal surface treatment and cleaning
4. Ultimate sludge disposal

Plating operations generally involve cyanide and hexavalent chromium. This type of waste requires pretreatment for cyanide destruction or chromate reduction before the wastes are intermixed with other plant discharges for treatment to remove the heavy metals as the hydroxides by precipitation. This involves separate collection systems for transferring these wastes to a treatment plant which is expensive and must be completely effective. These reactions take time to complete, so

rather large tankage and elaborate control systems are often required. These wastes are treatable if all factors are fully evaluated.

Emulsified oil solutions usually require pretreatment to break the emulsion and separate the solution into an oil layer and a water layer, which is then often mixed with the general plant waste for additional treatment. This pretreatment requires that these wastes be collected separately for transfer to a point of treatment. This process is most often a batch treatment process, so significantly sized tankage may be required. Chemical treatment may vary considerably even for individual plants; the control of operation represents a problem. Some emulsions are very difficult to break, possibly requiring usage of specialized techniques or chemicals.

Metal surface treatment often involves considerable quantities of acids and chromate. Considerable quantities of heavy metals may be present in this water, and large quantities of sludge may be generated when the solutions are neutralized and the heavy metals removed as the hydroxides by precipitation.

Ultimate disposal of the sludge produced in a variety of these plants is a continuously recurring problem. The treatment procedure used in this and other industries involves removal of contaminants from the water by converting them into an insoluble form, which is readily separated from the water by settling. However, these accumulated solids must be disposed of in some manner. Land fill operations have been utilized. This is an expedient solution but may not be satisfactory for the future. This represents one of the really pressing problems facing this, and other, industries.

F. Considering the range of products in this industrial segment and the variety of manufacturing steps involved, it is impossible at this time to classify plants on the basis of innovation, obsolescence and typical processes used.

There are approximately 1950[1] plants classified within the Motor Vehicle Industry. Stamping and assembly plants account for 93 plants, so there are approximately 1850 motor vehicle parts and accessories plants. Based on our knowledge of the industry it appears that there are approximately 150 plants that can be classified as medium or large plants. It appears that the majority of the remaining plants, some 1700, should be classified as small plants.

II. GROSS WASTE QUANTITIES BEFORE TREATMENT OR OTHER DISPOSAL

Due to the range of products produced by this industry and the number of plants involved, it is impossible at this time to determine the gross waste quantities produced by the industry before treatment or other disposal. Significantly more data is needed to provide this information.

III. WASTE REDUCTION PRACTICES

A. Processing Practices

The processes utilized in this segment of the industry are many and varied. It appears that in general changes in production technology will not materially alter the amount or type of water discharged.

B. Treatment Practices

1. The basis for our division of parts manufacturing operations was based on the type of waste generated. The treatment practice applied to each of the waste water streams is:

   Primarily Oil Containing Wastes

   For treatment of these wastes we have considered two cases:

   Case I

   If the soluble oil can be collected separately, the general plant waste requires treatment, and the amount of soluble oil to be treated is a significant percentage of the amount of oil being received at the treatment plant, then the treatment facility may actually consist of two parallel facilities. One facility would encompass batch holding tanks for emulsion breaking followed by chemical clarification facilities. In some cases it may be desired to blend the water with the general plant effluent for further treatment. Also, it may be desirable to directly discharge the waste to a stream or a municipal treatment plant. The other facility would be a flow through system and would include pH adjustment followed by chemical clarification and precipitation. A flow diagram of this system can be found in Exhibit XII.

Case II

If the soluble oil can be collected separately, the general plant waste requires treatment, and the amount of soluble oil to be treated is a small percentage of the total amount of oil requiring removal, then the facilities would consist of a batch emulsion breaking system with the effluent being blended with the general plant effluent which is then treated for pH adjustment and clarified by the addition of coagulants. Exhibit XIII is a flow diagram of this system.

In the following table no consideration will be given to handling the sludge produced by the waste treatment approaches.

297-025 O - 68 - 7

PRIMARILY OIL CONTAINING WASTE

	Removal Method	Normal Removal Efficiency	
		Oil	Suspended Solids
Case I	Separate soluble oil system consisting of emulsion breaking and clarification	99%	85-95%
	and		
	General plant system consisting of pH adjustment and clarification	75-95%	85-95%
Case II	Treatment of soluble oil containing waste by emulsion breaking followed by treatment of this and general plant waste by pH adjustment and clarification.	75-95%	85-95%

Primarily Non-Oil Containing Wastes

Solids and BOD Wastes

This stream would represent a water having a high suspended solids concentration and a relatively low organic content as measured by the BOD. These waters would be discharged into a lagoon where the solids would settle out. Periodically the solids would be removed by dredging for ultimate disposal. The lagoon would be sized so that the BOD load would be reduced by natural reaeration. Refer to Exhibit XIV.

Plating Wastes

This facility consists of sections for cyanide destruction, chromium reduction, pH adjustment and removal of heavy metals as the hydroxides by precipitation. The solids are dewatered and hauled away for ultimate disposal. A diagram of such a facility can be found in Exhibit XV.

Other Non-Oil Wastes

This facility would be the type wherein one stream would require pretreatment and the general plant waste would require pH adjustment and clarification. The amount of water requiring pretreatment is a small percentage of the total flow to be treated. Refer to Exhibit XVI.

The following table makes these assumptions:

1. While excess alkalinity or acidity are undesirable contaminants, no treatment efficiency will be given for pH adjustment as any desired final pH can be obtained by feeding acid or alkaline materials.

2. Flow and contaminant equalization will not be included in the table as it does not contribute to removal except that it is essential for proper functioning of the waste

water treatment facility.

3. Phosphate removal will not be considered except to note that it may, in some cases, have to be removed. The efficiency of the process for phosphate removal can be in the range of 95% if a significantly increased operating cost for chemical coagulants (alum and lime) is absorbed.

4. No consideration will be given to handling sludge produced by the waste treatment approaches.

PRIMARILY NON-OIL CONTAINING WASTES

Normal Removal Efficiency

Removal Method	Suspended Solids	BOD	CN	Cu	Ni	Cr^{+6}	Zn	Oil
Solids & BOD Wastes								
Solids settling and BOD removal by natural aeration	85-95%	85%	0	0	0	0	0	0
Plating Waste								
Cyanide destruction, chromium reduction, pH adjustment, precipitation of heavy metals, clarification	85-95%	0	to 0.1 mg/l	Ess. Comp.	to 1 mg/l	Ess. Comp.	Ess. Comp.	75-95%
Other Non-Oil Waste								
Pretreatment, pH adjustment, clarification	85-95%	0	to 0.1 mg/l	Ess. Comp.	to 1 mg/l	Ess. Comp.	Ess. Comp.	75-95%

2. The above treatment practices have been uniform since 1950. It is not expected that new technology will be required to handle the effluent waste waters discharged through 1977. There are a few isolated cases where the desired heavy metals content may not be attainable with presently used engineering practice. This picture is clouded by indeciveness as to whether some of the very low heavy metals concentrations are required for the receiving streams.

   When considering a stepwise approach to a given waste water situation, the order in which treatment steps may be considered is:

   a. pH adjustment
   b. Pretreatment of a waste such as cyanide destruction, chromium reduction, oil emulsion breaking
   c. Removal of free oil
   d. Clarification

   Introduction of one of these steps may necessitate addition of another at the same time. In other cases, installation of one or several of these practices may be all that is required for a given situation.

3-a. An estimate of the percent of industry waste water discharged to municipal sewers is 70%. It is the general feeling of the motor vehicle part and accessories industry that the desirable approach is to pretreat the waste water on site and then discharge it where possible to a municipal sewage system. Therefore, it is expected that this percentage should increase in the years to come.

3-b. When considering discharge to a municipal system the following constituents are generally considered:

   1. pH adjustment. Free acid or high alkalinity may cause operating problems in the collection

system and the municipal treatment plant.

2. Excessive free oil. Municipal sewage treatment plants are not prepared to handle too large a quantity of free oil.

3. Emulsified oil. Generally these wastes require at least an emulsion breaking step and separation of the resultant free oil before being discharged to a municipal system.

4. Heavy metal removal. Excessive quantities of heavy metals may cause operational problems in a secondary biological unit or in anaerobic sludge digestion. In some cases, removal of heavy metals may be all that is required, and the waste would in effect only be passing through the treatment plant without any actual purification occurring.

5. Excessive quantities of sludge. Some industrial plants discharge quantities of sludge to a municipal system overloading the municipal sludge handling facilities. This is in some cases a technical problem. In quite a few cases it appears that the municipal plant could handle the sludge more economically than having it handled by each industrial plant separately if the industrial load and characteristics had been considered more completely when the design of the municipal plant was finalized.

C. By-Product Utilization

This is not now a significant overall factor in pollution abatement costs, and it is not expected to be significant over the next decade.

It should be noted that plants are continuously reviewing their practices to determine whether a process change can reduce the amount of contaminants being discharged. A few cyanide and chromate recovery systems

have been installed. There is no universal trend toward recovery since it is not the most economical approach for all plants.

Oil removal as part of treatment plant operation may be considered as a by-product in that it is disposed of by hauling. Ultimately this oil may be repurified, or it may be utilized for oiling roads or as a fuel. The amount from each plant is generally too small to effect anything but a nominal dollar return from the recovery.

D. Base Year Net Waste Quantities

Due to the complexity and size of the motor vehicle parts and accessories industry it was not possible to determine the base year net waste quantities from this industry. Considerable additional data would have to be collected.

E. Projected Net Waste Quantities

Since sufficient time was not available for collection of complete data, the projected waste quantities from the motor vehicle parts and accessories industry could not be determined.

IV. WASTE REDUCTION OR REMOVAL COST INFORMATION

A. Due to insufficient information, it is not possible at this time to determine the replacement value of existing treatment facilities and annual operating costs and maintenance expenditures by the parts and accessories segment of the Motor Vehicle industry.

B. Estimated capital costs and annual operating costs for various types of waste treatment facilities are indicated in Exhibit XVII.

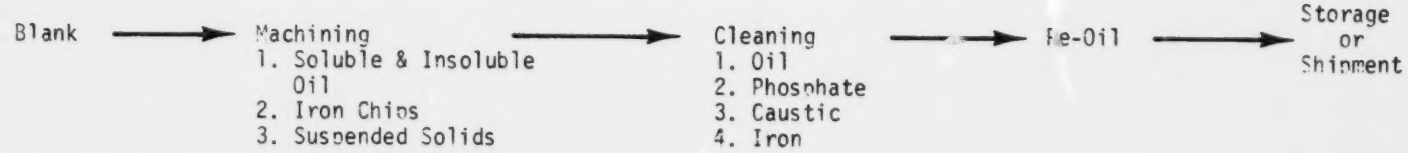
Due to insufficient information it is not possible to develop a true comprehensive estimate of the cost involved in resolving the problem for the parts and accessories plants. Nor is it possible to credit those segments of the industry who have already installed treatment facilities.

We estimate that the total capital expenditure by the parts and accessories section of the motor vehicle industry could be approximately $185,000,000. This does not include credit for facilities already installed. This number is based on the premise that there are approximately 150 medium to large parts and accessories plants who will spend on the average of $1,000,000 each to resolve their problem and, also, that there are 1700 small to medium sized parts and accessories plants who will spend, on the average, around $20,000 each to resolve their problem.

We estimate that the annual operating costs for these facilities would be in the range of $10-15,000,000.

MACHINING OPERATIONS
SIGNIFICANT POLLUTANTS

EXHIBIT I

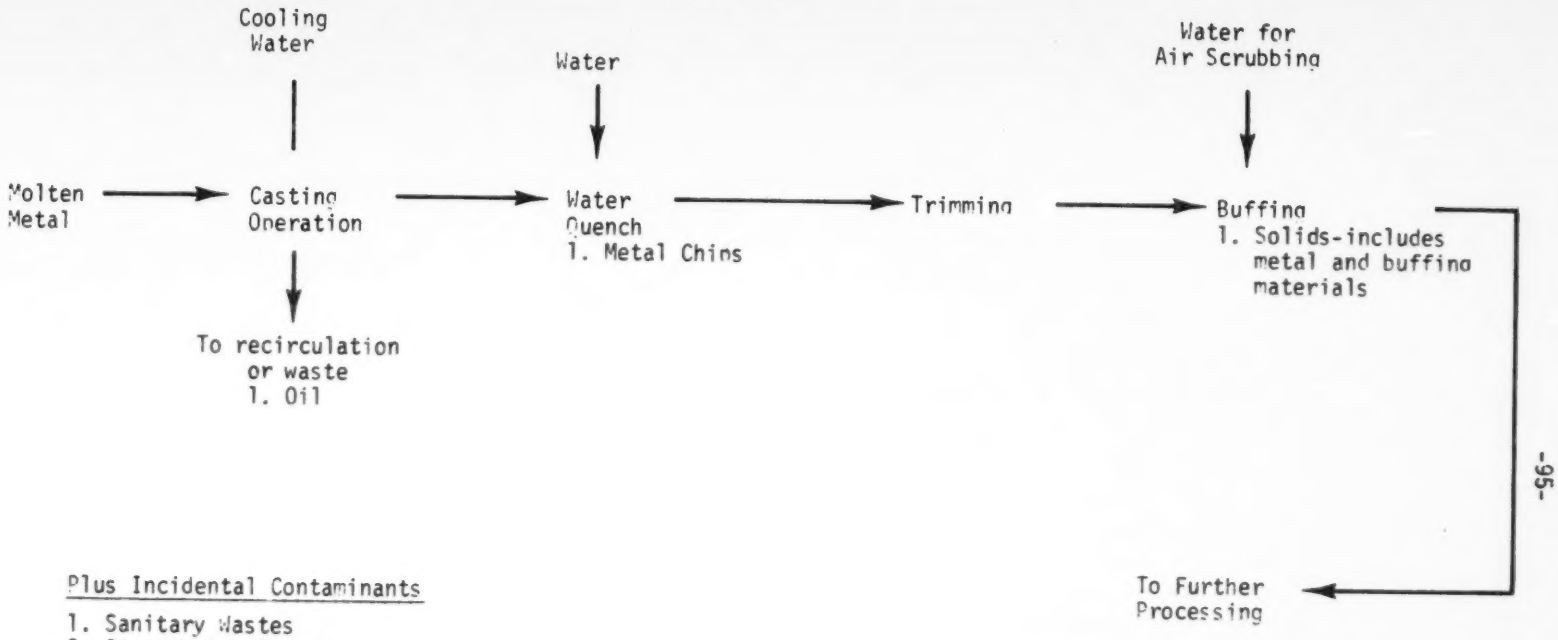


Plus Incidental Contaminants

1. Sanitary Wastes
2. Storm Water Runoff
3. Powerhouse Contaminants
   Boiler Blowdown
   Softener Regenerants
   Flyash
4. Cooling Tower Blowdown

DIE CAST OPERATIONS
SIGNIFICANT POLLUTANTS

EXHIBIT II

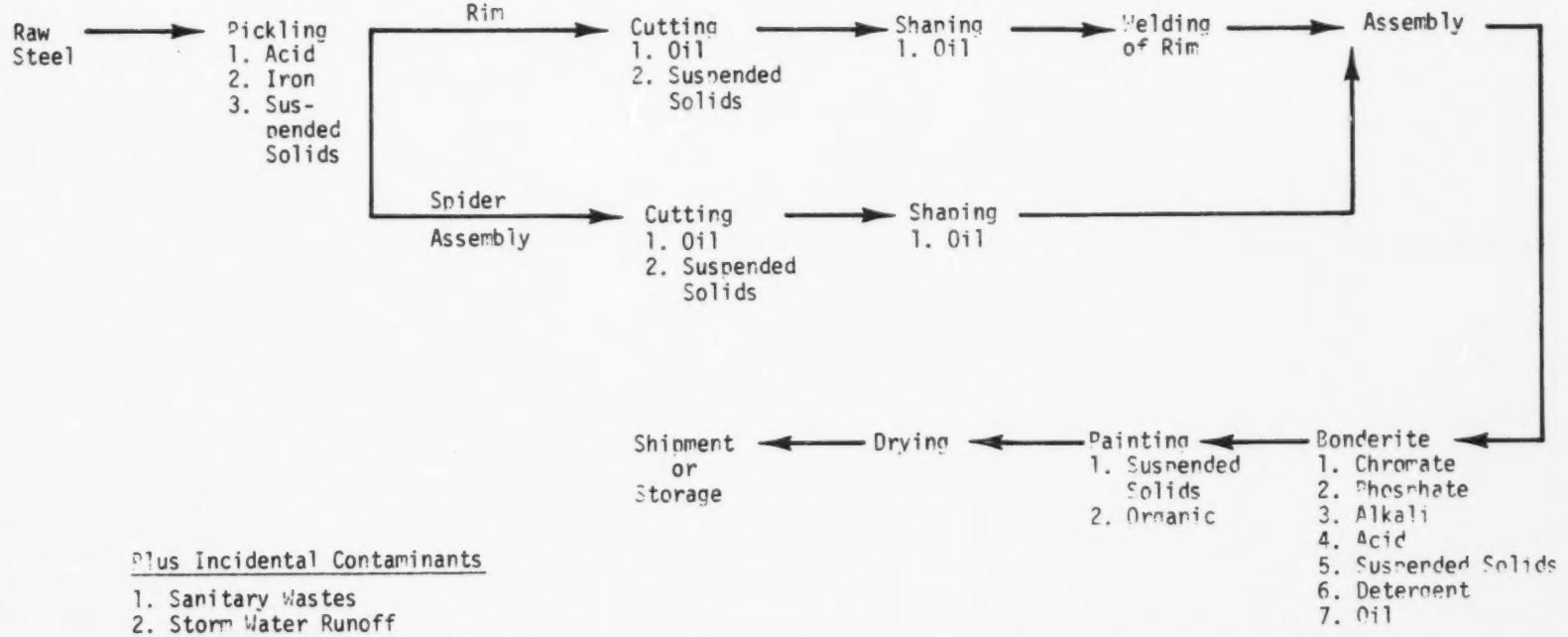


Plus Incidental Contaminants

1. Sanitary Wastes
2. Storm Water Runoff
3. Powerhouse Contaminants
   Boiler Blowdown
   Softener Regenerants
   Flyash
4. Cooling Tower Blowdown

WHEEL MANUFACTURING
SIGNIFICANT POLLUTANTS

EXHIBIT III

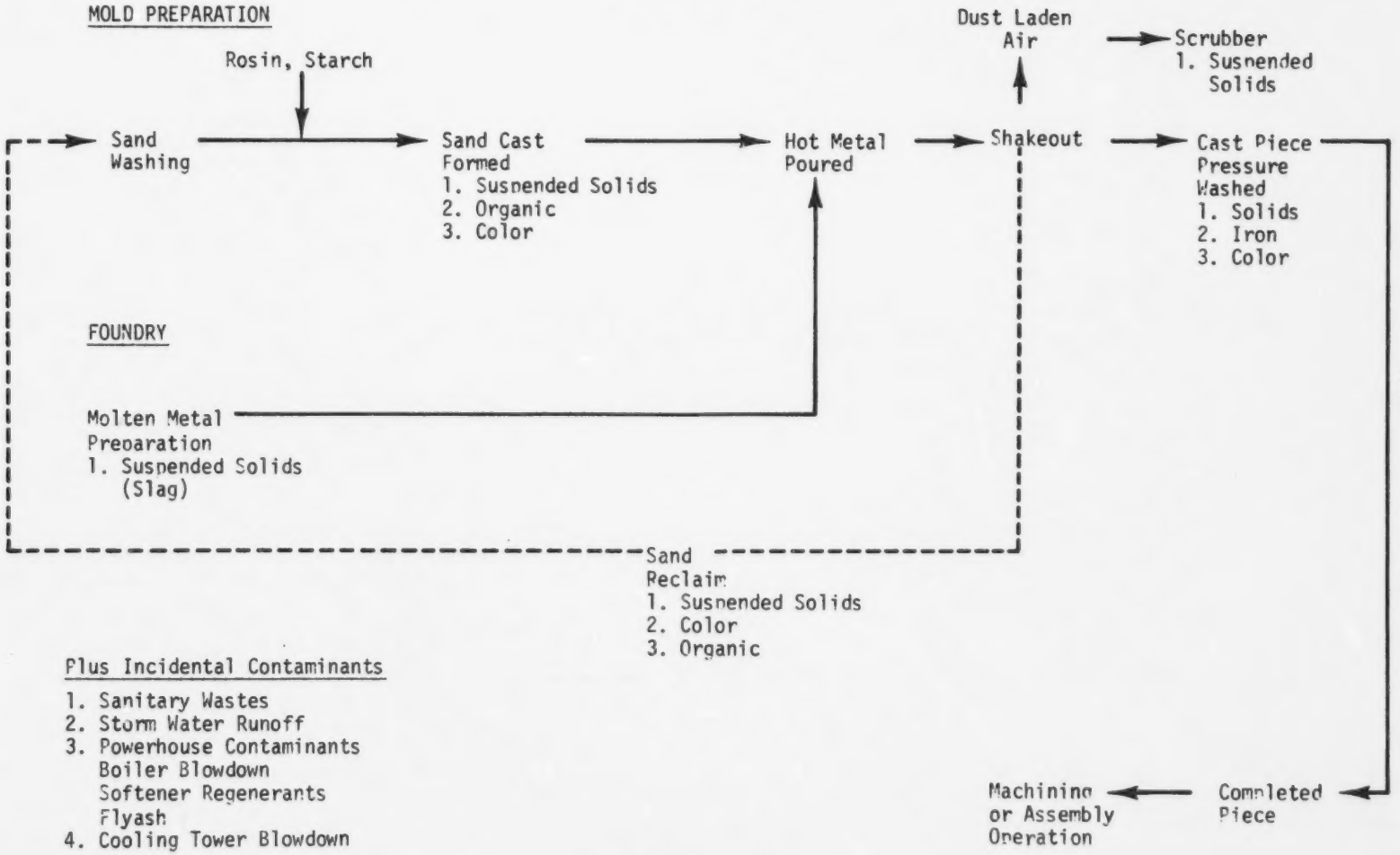


Plus Incidental Contaminants

1. Sanitary Wastes
2. Storm Water Runoff
3. Powerhouse Contaminants
   Boiler Blowdown
   Softener Regenerants
   Flyash
4. Cooling Tower Blowdown

METAL (SAND) CASTING OPERATIONS
SIGNIFICANT POLLUTANTS

EXHIBIT IV

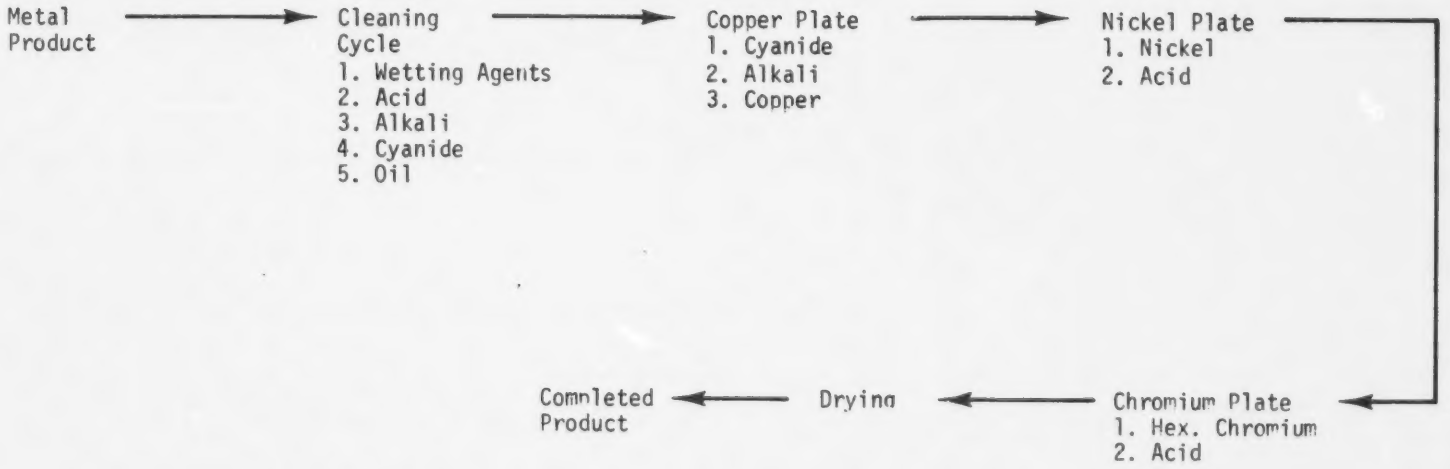


Plus Incidental Contaminants

1. Sanitary Wastes
2. Storm Water Runoff
3. Powerhouse Contaminants
   Boiler Blowdown
   Softener Regenerants
   Flyash
4. Cooling Tower Blowdown

PLATING OPERATIONS
SIGNIFICANT POLLUTANTS

EXHIBIT V

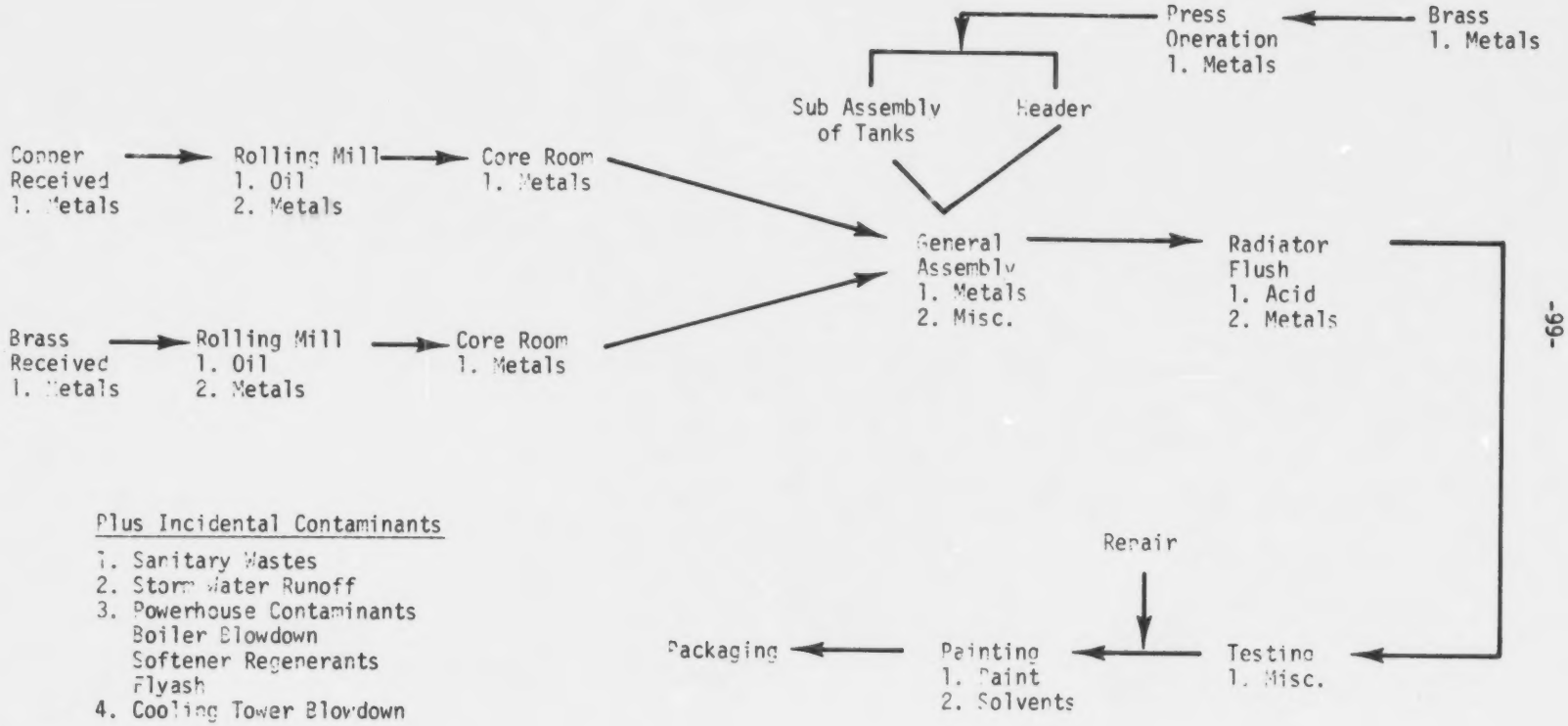


Plus Incidental Contaminants

1. Sanitary Wastes
2. Storm Water Runoff
3. Powerhouse Contaminants
   Boiler Blowdown
   Softener Regenerants
   Flyash
4. Cooling Tower Blowdown

RADIATOR MANUFACTURING
SIGNIFICANT POLLUTANTS

EXHIBIT VI

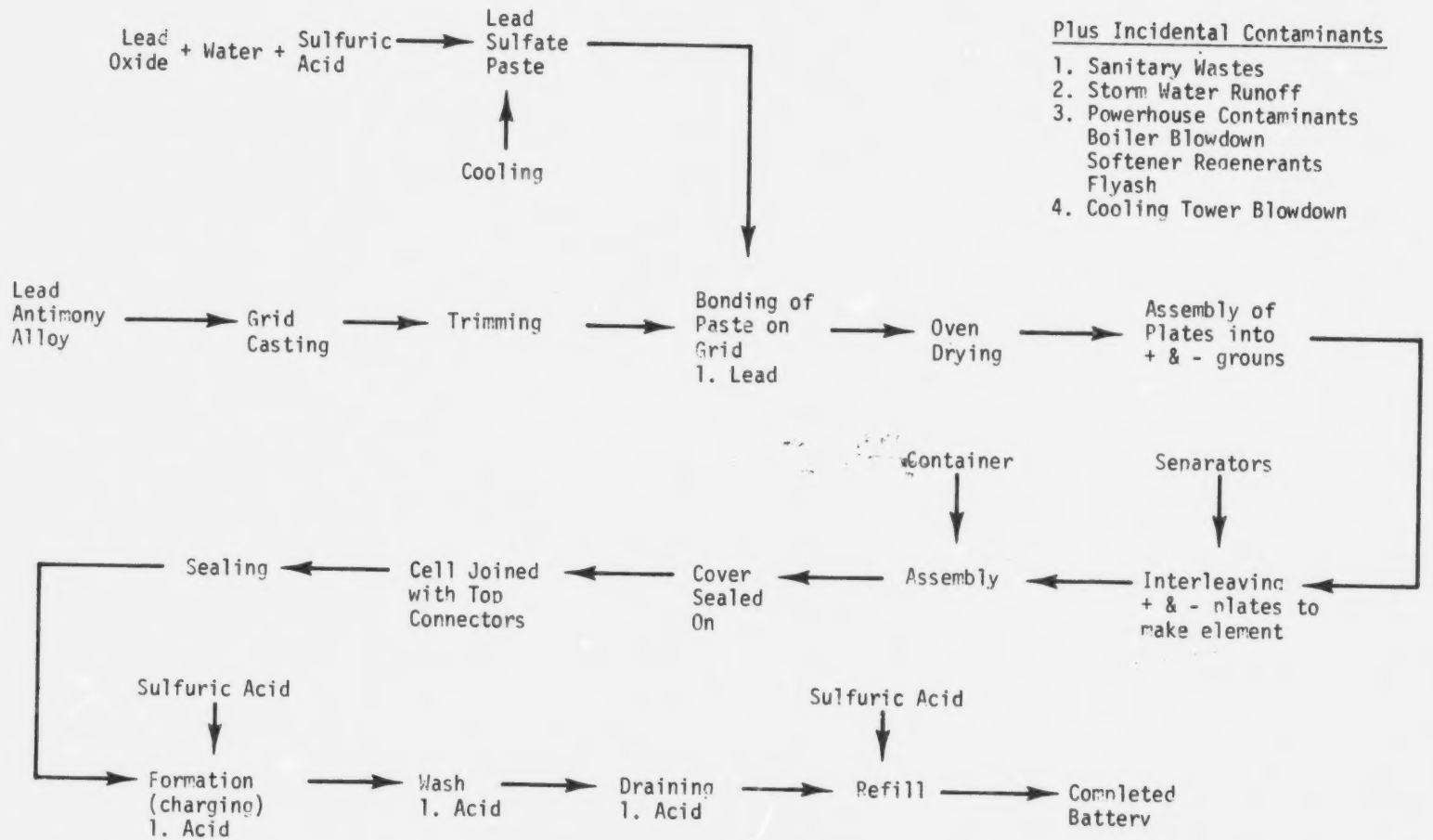


Plus Incidental Contaminants

1. Sanitary Wastes
2. Storm Water Runoff
3. Powerhouse Contaminants
   Boiler Blowdown
   Softener Regenerants
   Flyash
4. Cooling Tower Blowdown

WET BATTERY MANUFACTURING
SIGNIFICANT POLLUTANTS

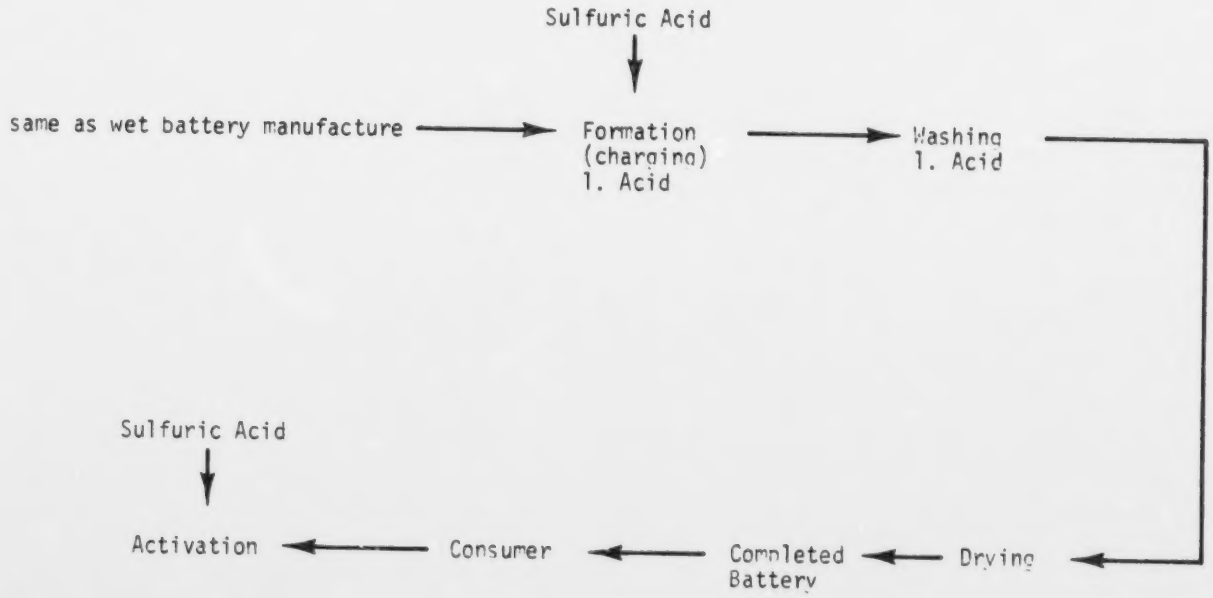
EXHIBIT VII-A



Acid possibly discharged from filling of tanks.

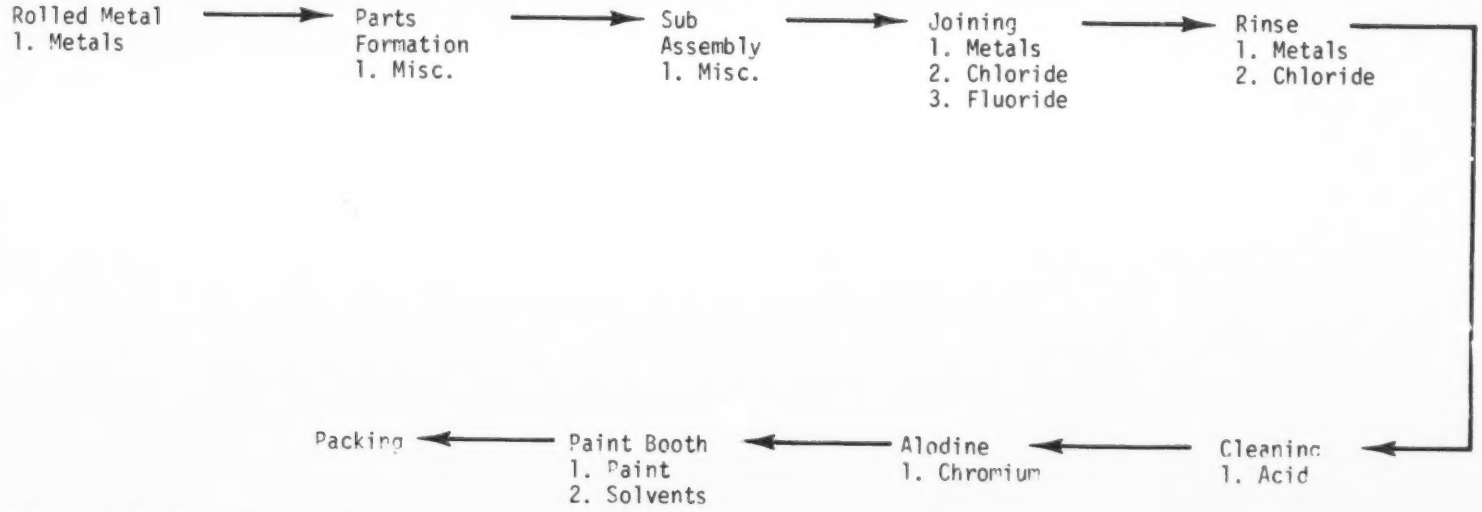
DRY BATTERY MANUFACTURING
SIGNIFICANT POLLUTANTS

EXHIBIT VII-B



AUTOMOBILE AIR CONDITIONER MANUFACTURING
SIGNIFICANT POLLUTANTS

EXHIBIT VIII

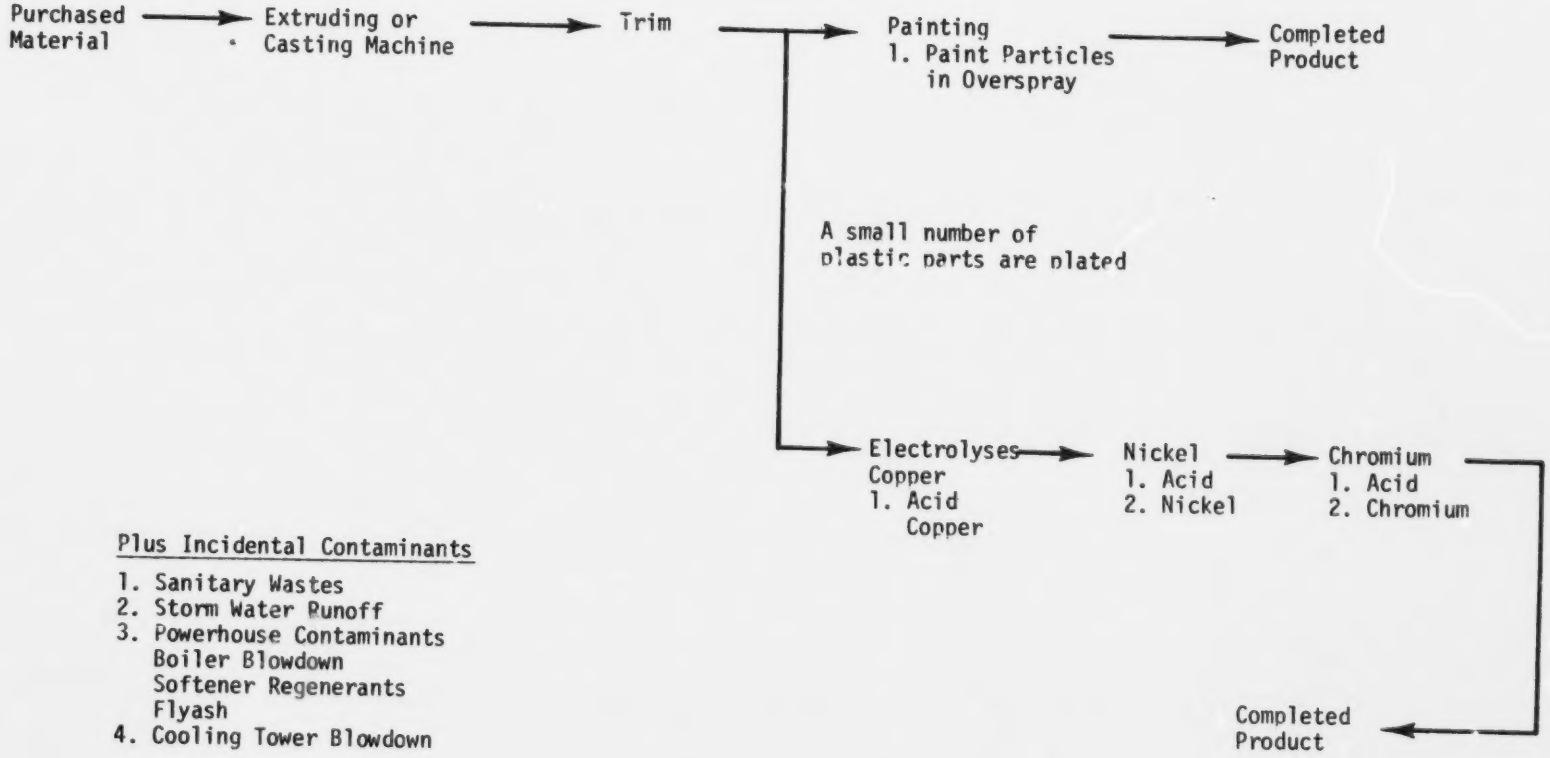


Plus Incidental Contaminants

1. Sanitary Wastes
2. Storm Water Runoff
3. Powerhouse Contaminants
   Boiler Blowdown
   Softener Regenerants
   Flyash
4. Cooling Tower Blowdown

PLASTIC PARTS MANUFACTURING
SIGNIFICANT POLLUTANTS

EXHIBIT IX

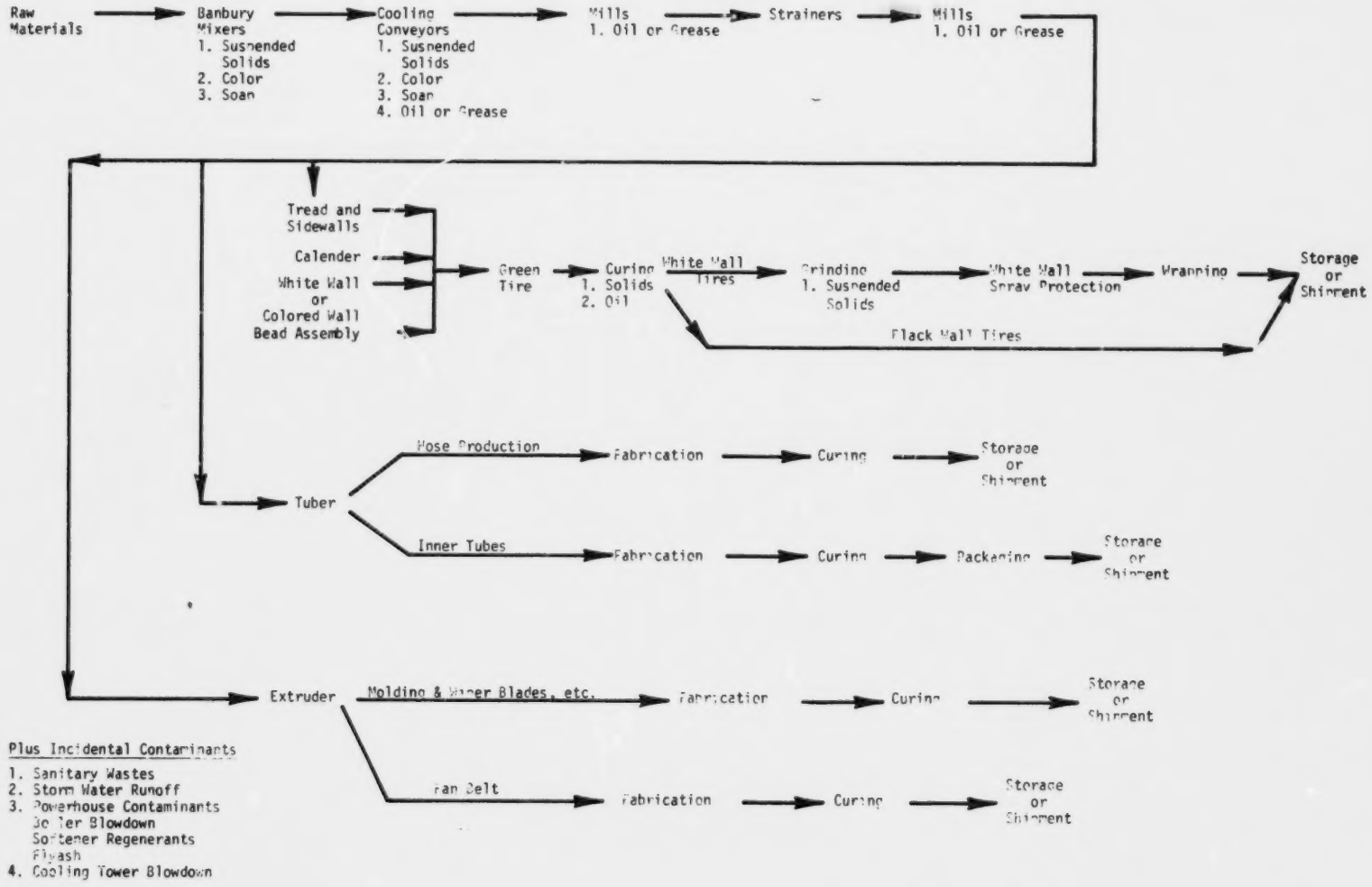


Plus Incidental Contaminants

1. Sanitary Wastes
2. Storm Water Runoff
3. Powerhouse Contaminants
   Boiler Blowdown
   Softener Regenerants
   Flyash
4. Cooling Tower Blowdown

RUBBER PRODUCTS MANUFACTURING
(TIRES, HOSES, FAN BELTS, EXTRUDED RUBBER MOLDING, WIPER BLADES, TUBES, ETC.)
SIGNIFICANT POLLUTANTS

EXHIBIT X

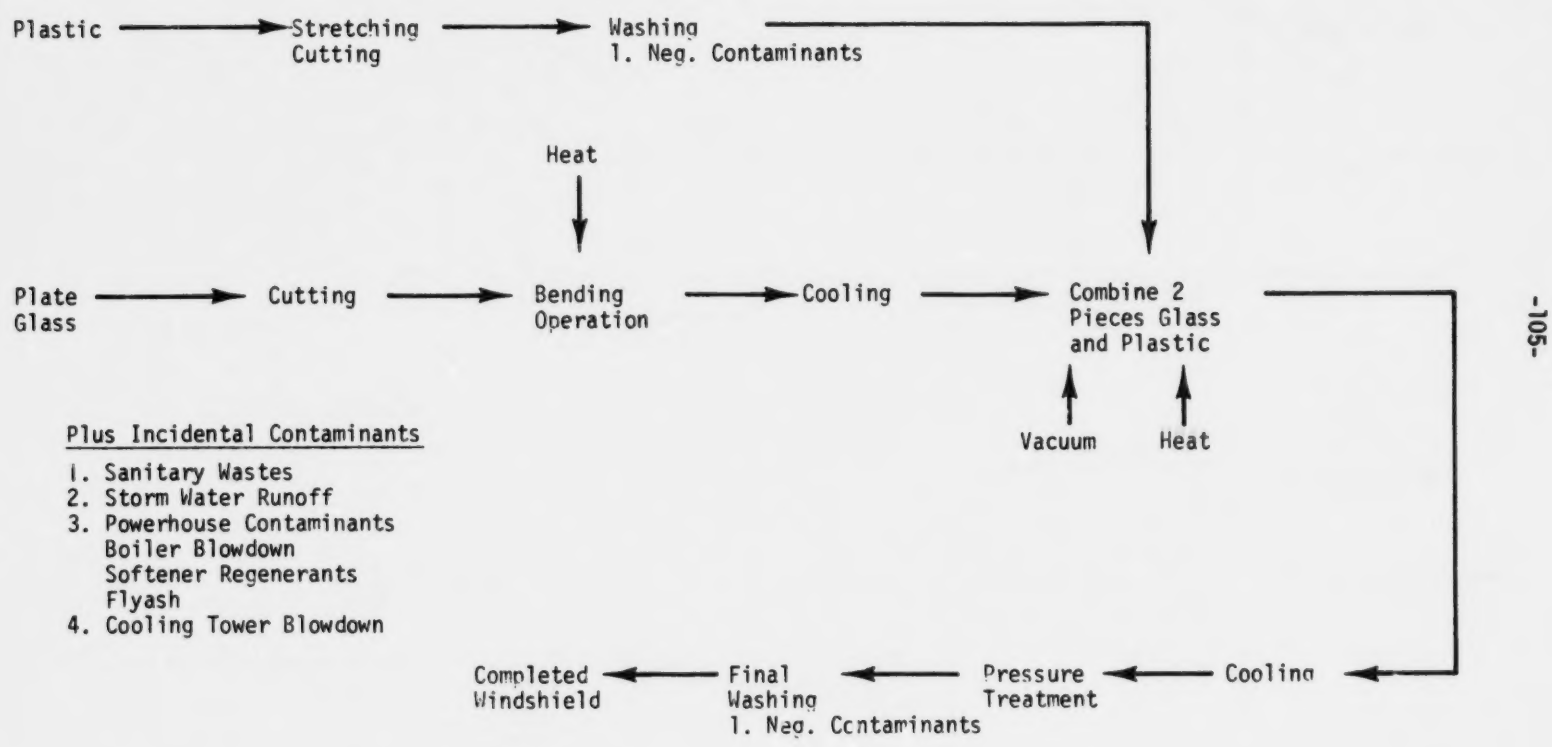


Plus Incidental Contaminants

1. Sanitary Wastes
2. Storm Water Runoff
3. Powerhouse Contaminants
   Boiler Blowdown
   Softener Regenerants
   Flyash
4. Cooling Tower Blowdown

WINDSHIELD MANUFACTURING
SIGNIFICANT POLLUTANTS

EXHIBIT XI

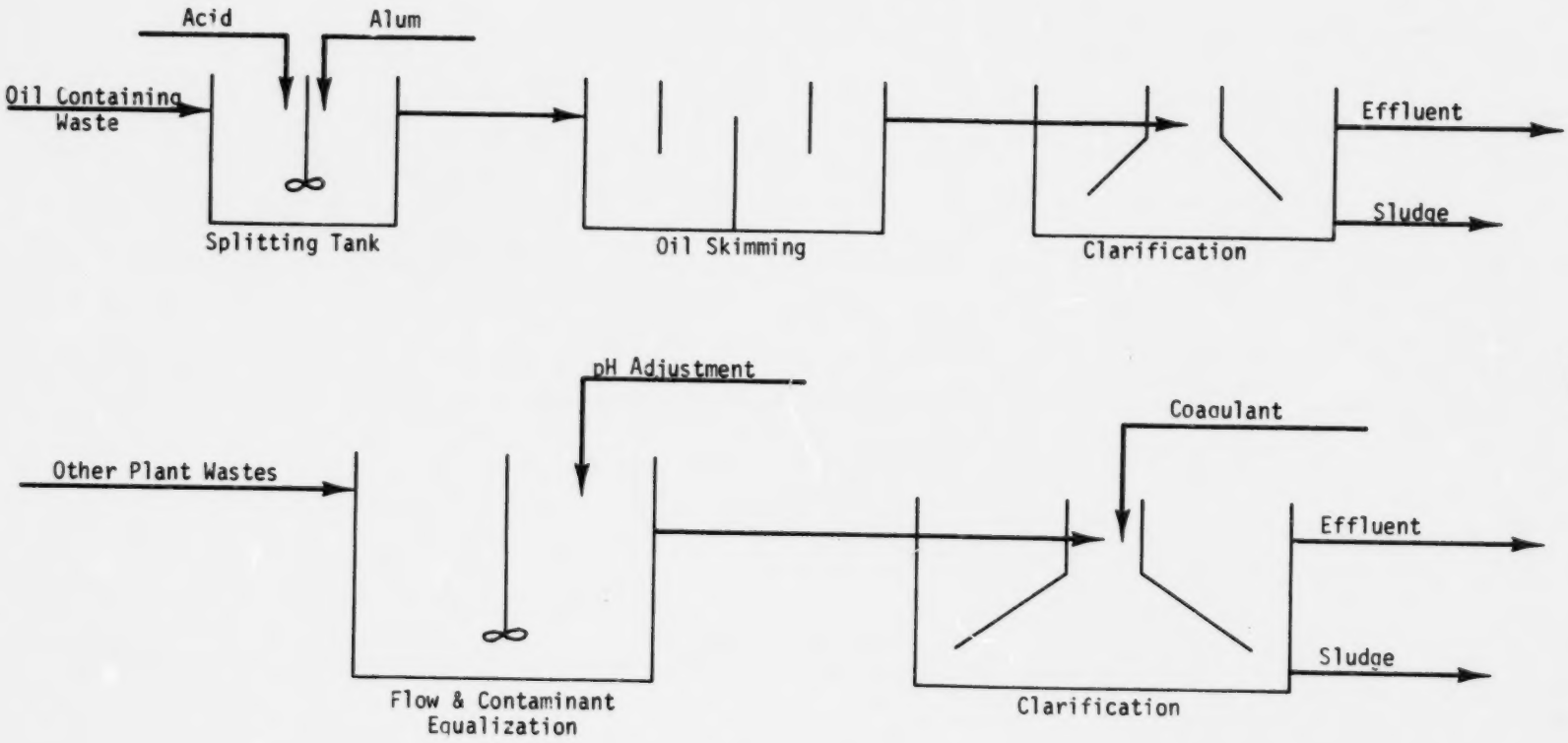


Plus Incidental Contaminants

1. Sanitary Wastes
2. Storm Water Runoff
3. Powerhouse Contaminants
   Boiler Blowdown
   Softener Regenerants
   Flyash
4. Cooling Tower Blowdown

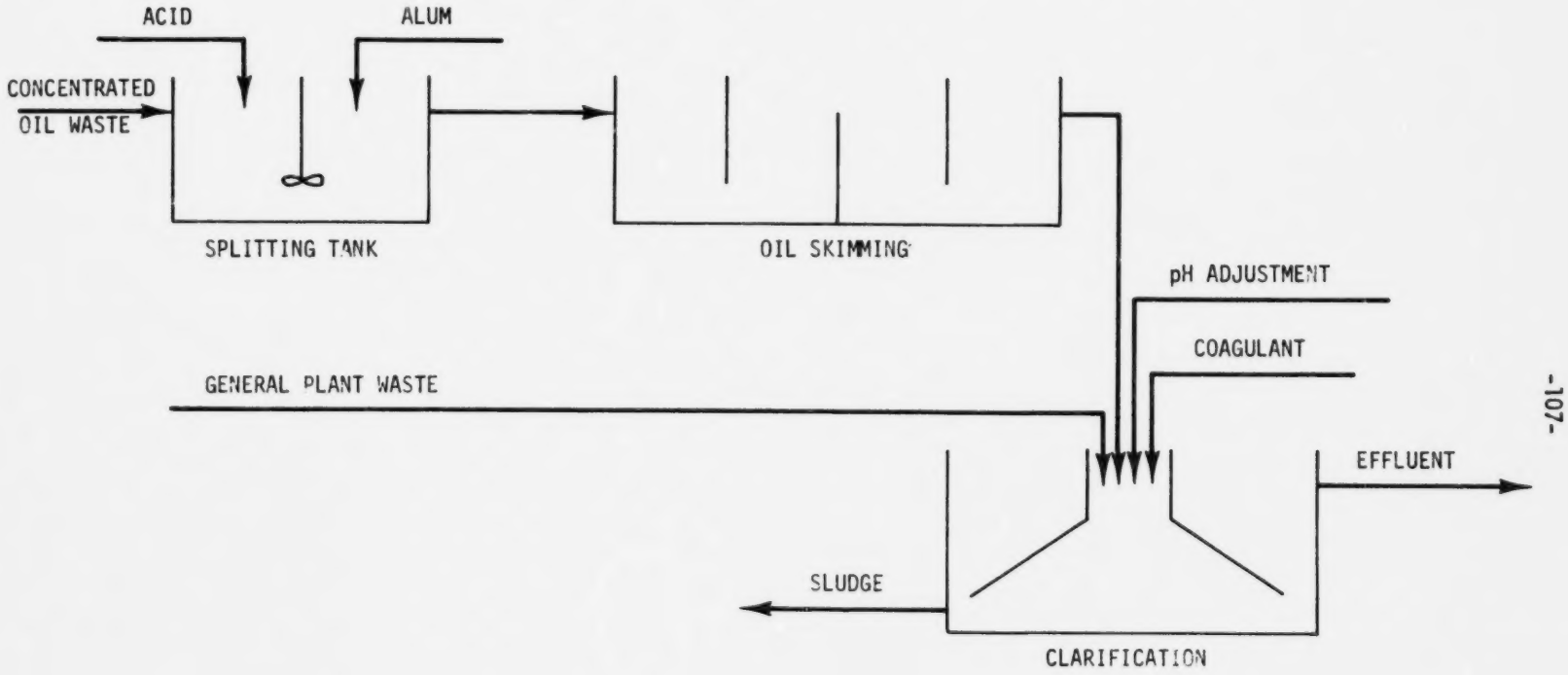
OIL WASTE TREATMENT FACILITIES - CASE I

EXHIBIT XII



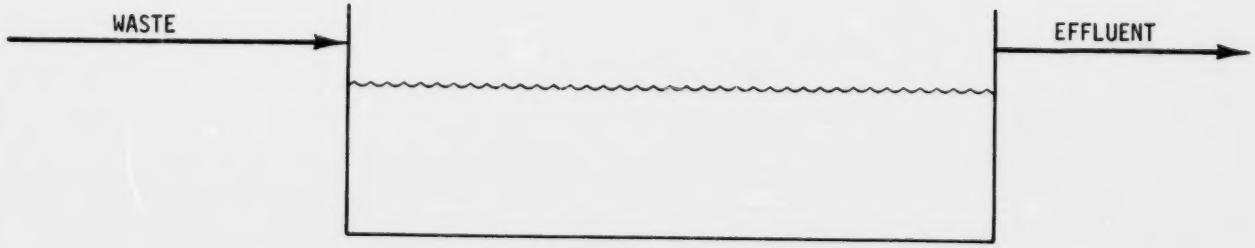
OIL WASTE TREATMENT FACILITIES - CASE II

EXHIBIT XIII



FOUNDRY WASTE TREATMENT FACILITIES

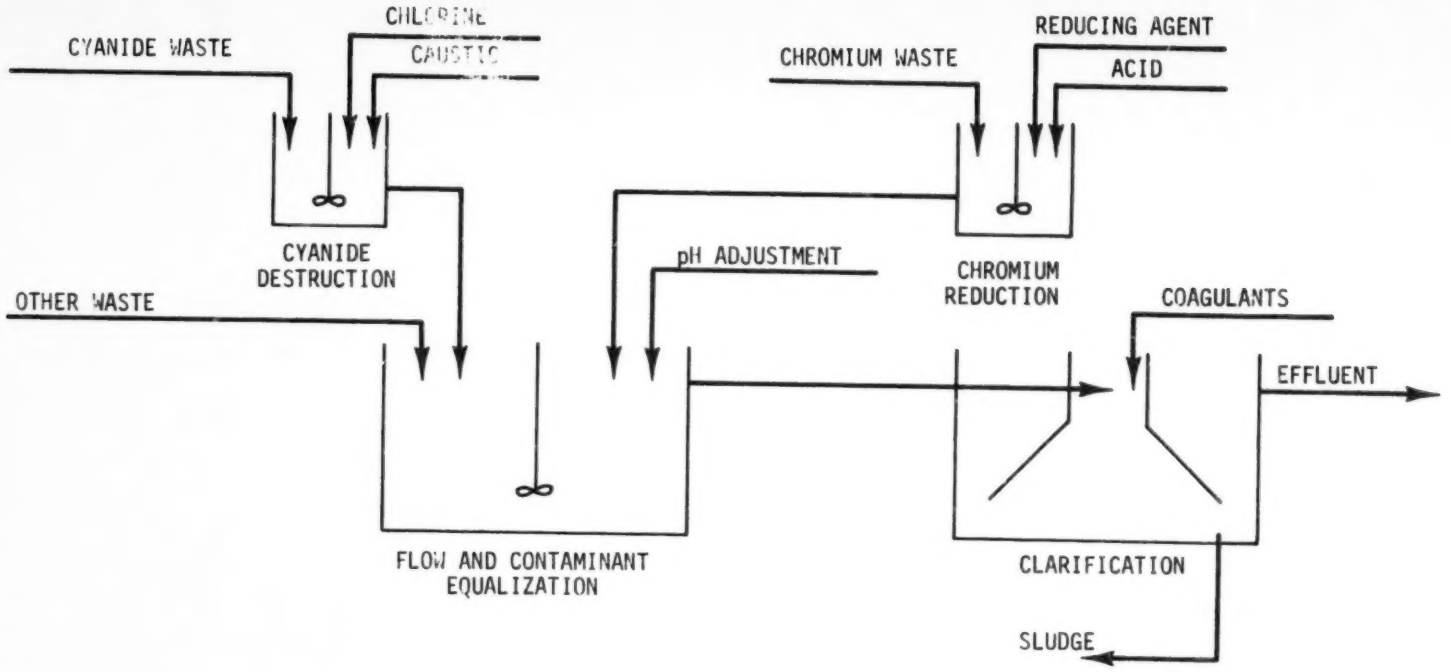
EXHIBIT XIV



LAGOON - THICKENER

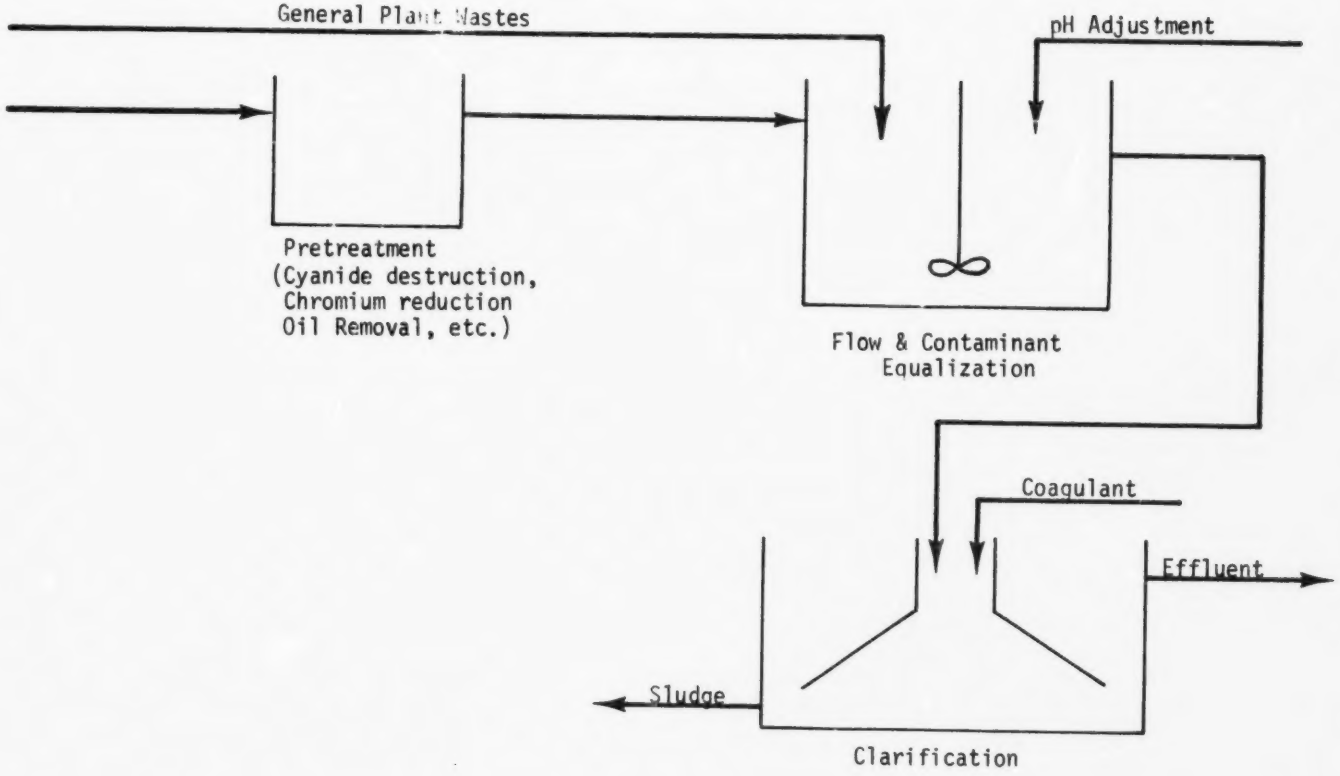
PLATING WASTE TREATMENT FACILITIES

EXHIBIT XV



TYPICAL NON-OIL WASTE TREATMENT FACILITIES

EXHIBIT XVI



REPRESENTATIVE CAPITAL AND ANNUAL OPERATING COSTS
ASSOCIATED WITH WASTE WATER VOLUMES
FOR PARTS PLANTS

EXHIBIT XVII

OIL WASTES

	CAPITAL COSTS ($X10^3$)	ANNUAL OPERATING COSTS ($X10^3$)		ECONOMIC LIFE
SMALL PLANT - 200 GPM				
25% of Flow-Clarification 75% of Flow-pH Adjustment, Clarification, Solids Handling	200.00	Chemicals Labor Maintenance & Repairs Power	5.52 20.00 2.50 2.00	
TOTAL CAPITAL COSTS	200.00	TOTAL OPERATING COSTS	30.02	25 YEARS
MEDIUM PLANT - 1200 GPM				
25% of Flow-Clarification 75% of Flow-pH Adjustment, Clarification, Solids Handling	1,200.00	Chemicals Labor Maintenance & Repairs Power	33.09 40.00 12.00 12.00	
TOTAL CAPITAL COSTS	1,200.00	TOTAL OPERATING COSTS	97.09	25 YEARS
LARGE PLANT - 6500 GPM				
Splitting, Skimmer, pH Adjustment, Clarification, Solids Handling	4,000.00	Chemicals Labor Maintenance & Repairs Power	165.00 80.00 40.00 40.00	
TOTAL CAPITAL COSTS	4,000.00	TOTAL OPERATING COSTS	325.00	25 YEARS

COLLECTION SYSTEM COST $300,000 PER PLANT

CONTINGENCY FOR ENGINEERING, SITE PREPARATION, BUILDINGS 30%

REPRESENTATIVE CAPITAL AND ANNUAL OPERATING COSTS
ASSOCIATED WITH WASTE WATER VOLUMES
FOR PARTS PLANTS

EXHIBIT XVII
Page 2

SOLIDS AND BOD WASTES

	CAPITAL COSTS ($X10^3$)	ANNUAL OPERATING COSTS ($X10^3$)		ECONOMIC LIFE
SMALL PLANT - 750 GPM				
Lagoon - Thickener	100.00	Labor	1.00	
		Maintenance & Repairs	1.00	
TOTAL CAPITAL COSTS	100.00	TOTAL OPERATING COSTS	2.00	25 YEARS
MEDIUM PLANT - 1900 GPM				
Lagoon - Thickener	170.00	Labor	1.00	
		Maintenance & Repairs	2.00	
TOTAL CAPITAL COSTS	170.00	TOTAL OPERATING COSTS	3.00	25 YEARS
LARGE PLANT - 10,000 GPM				
Lagoon - Thickener	750.00	Labor	1.00	
		Maintenance & Repairs	7.50	
TOTAL CAPITAL COSTS	750.00	TOTAL OPERATING COSTS	8.50	25 YEARS

THERE ARE NO CHEMICAL OR POWER COSTS ASSOCIATED WITH THESE TREATMENT FACILITIES
NO LABOR CHARGE HAS BEEN INCLUDED FOR SOLIDS REMOVAL

COLLECTION SYSTEM COSTS $50,000 PER PLANT

CONTINGENCY FOR ENGINEERING, SITE PREPARATION, BUILDINGS 20%

REPRESENTATIVE CAPITAL AND ANNUAL OPERATING COSTS
ASSOCIATED WITH WASTE WATER VOLUMES
FOR PARTS PLANTS

EXHIBIT XVII
Page 3

PLATING WASTES

	CAPITAL COSTS ($X10^3$)	ANNUAL OPERATING COSTS ($X10^3$)		ECONOMIC LIFE
SMALL PLANT - 200 GPM				
Cyanide Destruction, Chromium Reduction, pH Adjustment, Clarification, Solids Handling	250.00	Chemicals	8.65	
		Labor	30.00	
		Maintenance & Repairs	2.50	
		Power	0.72	
TOTAL CAPITAL COSTS	250.00	TOTAL OPERATING COSTS	41.87	25 YEARS
MEDIUM PLANT - 1500 GPM				
Cyanide Destruction, Chromium Reduction, pH Adjustment, Clarification, Solids Handling	1,000.00	Chemicals	65.00	
		Labor	50.00	
		Maintenance & Repairs	10.00	
		Power	5.40	
TOTAL CAPITAL COSTS	1,000.00	TOTAL OPERATING COSTS	130.40	25 YEARS
LARGE PLANT - 4000 GPM				
Cyanide Destruction, Chromium Reduction, pH Adjustment, Clarification, Solids Handling	2,500.00	Chemicals	173.36	
		Labor	80.00	
		Maintenance & Repairs	25.00	
		Power	14.40	
TOTAL CAPITAL COSTS	2,500.00	TOTAL OPERATING COSTS	292.76	25 YEARS

COLLECTION SYSTEM COSTS $600,000 PER PLANT

CONTINGENCY FOR ENGINEERING, SITE PREPARATION, BUILDINGS 35%

REPRESENTATIVE CAPITAL AND ANNUAL OPERATING COSTS
ASSOCIATED WITH WASTE WATER VOLUMES
FOR PARTS PLANTS

EXHIBIT XVII
Page 4

OTHER NON-OIL WASTES

	CAPITAL COSTS ($X10^3$)	ANNUAL OPERATING COSTS ($X10^3$)		ECONOMIC LIFE
SMALL PLANT - 200 GPM				
Either Cyanide Destruction, Chromium Reduction or Oil Removal, Followed By pH Adjustment, Clarification, Solids Handling	200.00	Chemicals Labor Maintenance & Repairs Power	4.56 30.00 2.00 0.72	
TOTAL CAPITAL COSTS	200.00	TOTAL OPERATING COSTS	37.28	25 YEARS
MEDIUM PLANT - 1500 GPM				
Either Cyanide Destruction, Chromium Reduction or Oil Removal, Followed By pH Adjustment, Clarification, Solids Handling	750.00	Chemicals Labor Maintenance & Repairs Power	34.23 50.00 7.50 5.00	
TOTAL CAPITAL COSTS	750.00	TOTAL OPERATING COSTS	96.73	25 YEARS
LARGE PLANT - 5000 GPM				
Either Cyanide Destruction, Chromium Reduction or Oil Removal, Followed By pH Adjustment, Clarification, Solids Handling	1,800.00	Chemicals Labor Maintenance & Repairs Power	114.10 70.00 20.00 15.00	
TOTAL CAPITAL COSTS	1,800.00	TOTAL OPERATING COSTS	219.10	25 YEARS

COLLECTION SYSTEM COSTS $500,000 PER PLANT

CONTINGENCY FOR ENGINEERING, SITE PREPARATION, BUILDINGS 35%

ACKNOWLEDGEMENT

We wish to express our appreciation to the automotive industry for their assistance in providing information which served as the basis for our evaluation and preparation of this report.

Specific information was gathered from General Motors Corporation, Ford Motor Company and Chrysler Corporation.

Respectfully submitted,

WATER MANAGEMENT DIVISION
CALGON CORPORATION

E. G. Paulson
Manager
Process & Waste Water Engineering

REFERENCES

1 Automobile Manufacturers Association, Automobile Facts & Figures - 1966.

2 McGraw-Hill Department of Economics Report, The American Economy Prospects For Growth Through 1980, September 1965.

U. S. Department of Commerce, Census of Manufacturers - Water Use In Manufacturing, 1963.

U.S. GOVERNMENT PRINTING OFFICE : 1968 O - 287-025